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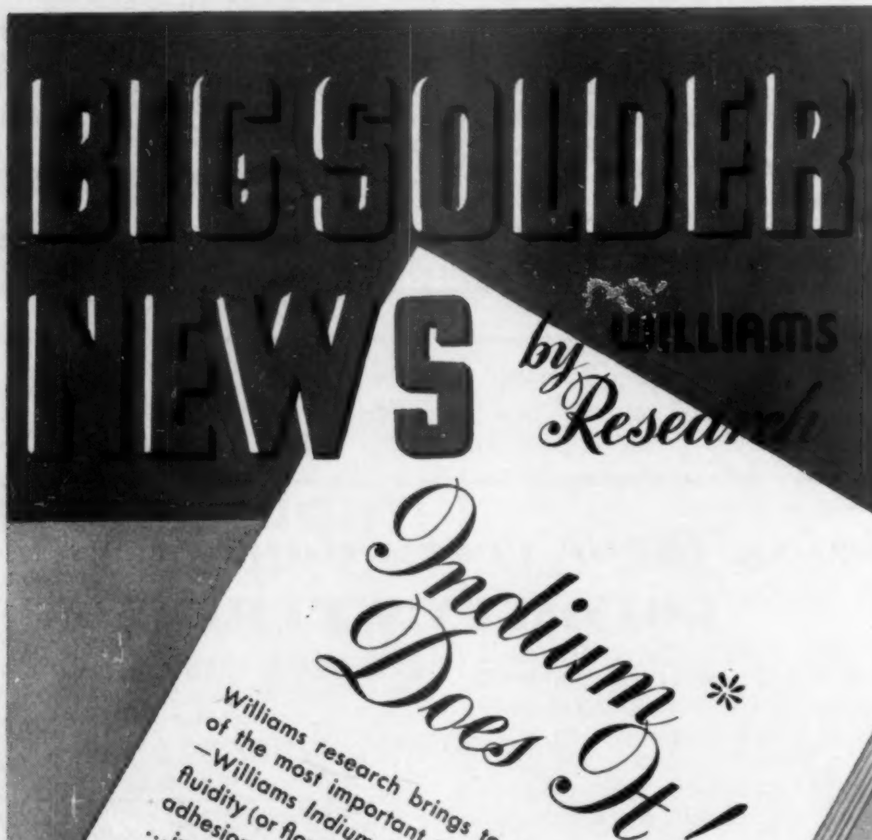
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JANUARY, 1945

Orthodontics

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American Journal of Orthodontics and Oral Surgery

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Original Articles

ORTHODONTICS AND TRANSEPTAL FIBERS

A HISTOLOGICAL INTERPRETATION OF REPAIR PHENOMENA FOLLOWING THE REMOVAL OF FIRST PREMOLARS WITH RETRACTION OF THE ANTERIOR SEGMENT

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IT HAS been observed in orthodontic cases in which the plan of treatment involved the removal of first premolars, followed by retraction of the anterior segment of the arch so as to bring canines into approximation with second premolars, that the character of the contact thus obtained between canine and second premolar is different from that prevailing between teeth in normal approximation, the difference consisting in the fact that the canine-second premolar contact lacks the lively resilience to the passage of dental floss found in the case of teeth in normal approximation. The endeavor to ascertain whether this difference in quality of contact might be associated with some difference in the structure of the transeptal fibers in the two instances supplied the motive for the orthodontic experiment here reported. At the same time, the experiment served to answer the question of what happens to the transeptal fibers when, in orthodontic treatment, wide spaces are opened temporarily between teeth which should normally be in approximation, as, for example, when buccal segments are moved distally one tooth at a time.

Two persons were selected as subjects. The first was a white woman, 50 years of age, in poor health, with mild involvement of the dental investing

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The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large, Article 113, Paragraph 2, U. S. Naval Regulations.

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structures. The left upper first premolar and the right lower first premolar were removed. Steel bands were placed on the left upper canine, the left upper second premolar, the right lower canine, and the right lower second premolar. A universal (Atkinson) bracket was welded to each of the bands. On each side the canine and the second premolar were moved into approximation by means of a fine steel wire 0.010 inch in diameter, fashioned into a contractile coil spring and fastened into the universal brackets. As the teeth moved under the influence of the contractile coil spring, excessive tipping of the roots was prevented by means of flexible levers of 0.015 inch round steel wire attached to the brackets in a manner demonstrated by Spencer R. Atkinson. After thirteen months of this treatment the teeth were in approximation, with the root tipping considerably corrected. They were then retained, with the appliance in position, for an additional period of eleven months, when it was judged that the time was at hand for their removal preparatory to microscopic sectioning. There was thus an elapsed period of two years between the time of commencing orthodontic movement of the teeth and the time of their removal for histological study.

On each side, then, the canine and the second premolar that had been subjected to movement were removed in a block[1] in such manner as to preserve intact normal relationship of the teeth, the periodontal membrane, the alveolar process, and the enveloping soft tissues. For control purposes there was removed in similar manner an additional block containing the left lower canine and the left lower lateral, neither of which had been subjected to any treatment whatever.

After removal, all blocks were placed in 10 per cent formalin for fixation and sent to the Registry of Dental and Oral Pathology, Army Medical Museum, Washington, D. C., for histological preparation.

Except for the construction of dentures, this ended the clinical phase of the experiment on the first subject.

The second subject selected was a well-nourished Negro man, 46 years of age, suffering from arthritis, and showing moderate to advanced periodontal disease, as observed clinically and by x-ray. Both upper first premolars were removed, and by means of appliances identical with those described for the first subject, the left upper canine was moved into approximation with the left upper second premolar, and the right upper canine into approximation with the right upper second premolar. This subject afforded the opportunity for investigation of the second question to be answered by the experiment, namely, what happens to transeptal fibers when in orthodontic treatment teeth become widely separated—the opportunity coming about through the fact that in approximating the left upper canine and the left upper second premolar, wide spaces, demonstrable by the x-ray, were opened between the left upper first molar and the left upper second premolar on the one hand, and between the left upper canine and the left upper lateral incisor on the other, and again on the right side a space was similarly opened between the right upper canine and the right upper lateral incisor. In this case the duration of the orthodontic treatment was again thirteen months. Retention, however, was limited to five months, when it

was decided to operate for blocks. In this case, then, the total elapsed period between the time of commencing orthodontic movement of the teeth and the time of their removal for histological study was one and one-half years.

Two blocks were taken, in the same manner as in the first subject, and included, in the case of the one block, the left upper second premolar, the left upper canine, and the left upper lateral incisor; and in the case of the other block, the right upper second premolar, the right upper canine, and the right upper lateral incisor. The blocks were handled in the same manner as in the case of the first subject.

Transeptal fibers are always found between the teeth, irrespective of the remaining amount of alveolar bone that supports them. This structural arrangement is shown in Figs. 1 to 4 inclusive.

Fig. 1 shows an interdental papilla of two lower molars. The epithelial attachments have migrated apically to a distance where they can now be classified as type IV. Yet the transeptal fibers *TS* appear to be in excellent tone. Fig. 2 is a higher magnification of these fibers. A small amount of the crest of the alvelolar bone has been lost, and the transeptal fibers *TS* appear to be normal in their size and arrangement.

Fig. 3 is a low magnification of four lower anterior teeth from which one-half to two-thirds of the alveolar bone has been lost. The transeptal fibers *TS*, in good arrangement, can be demonstrated above each alveolar crest. Fig. 4 is a low magnification of a molar root separated from the remainder of the tooth by a carious process. Subsequent infection caused considerable periodontal membrane and bone destruction; yet transeptal fibers *TS* persist in the apical region.

It is apparent, then, that new groups of transeptal fibers are continually being built as those groups above are being destroyed. There is evidence in our material that the alveolar crest fibers, together with the connective tissue matrix of the disappearing alveolar bone, furnish these new transeptal fibers (Figs. 12 and 13). Their persistence signifies their importance and necessity to the support of the teeth.

Figs. 5 to 8 inclusive are low magnifications of extraction spaces that have healed. In the repair process following the removal of the various teeth, the transeptal fibers remaining in the interdental papillae fused with the connective tissue scar over the alveoli of the extracted teeth to form a new, but elongated, group of transeptal fibers. This process of healing confirms the observation of Chase and Revesz.[2] Even the interdental papillae of the extracted teeth remain prominent for a long time. This, then, is the status of the structural arrangement that one encounters after the removal of a premolar to rearrange the remaining teeth in the arch.

Fig. 9 shows "before and after" radiographs of the first patient, from whom the left upper first premolar had been removed. The second premolar was moved bodily for a distance of 5 mm. to take the place of the first premolar.

Fig. 10 is a low magnification of the block removed from the jaw. *C* is the canine; *P2* is the second premolar. Two types of force were applied to the second premolar before it assumed its present position. First there was a mesial tipping of the crown; second, a bodily movement of the root.

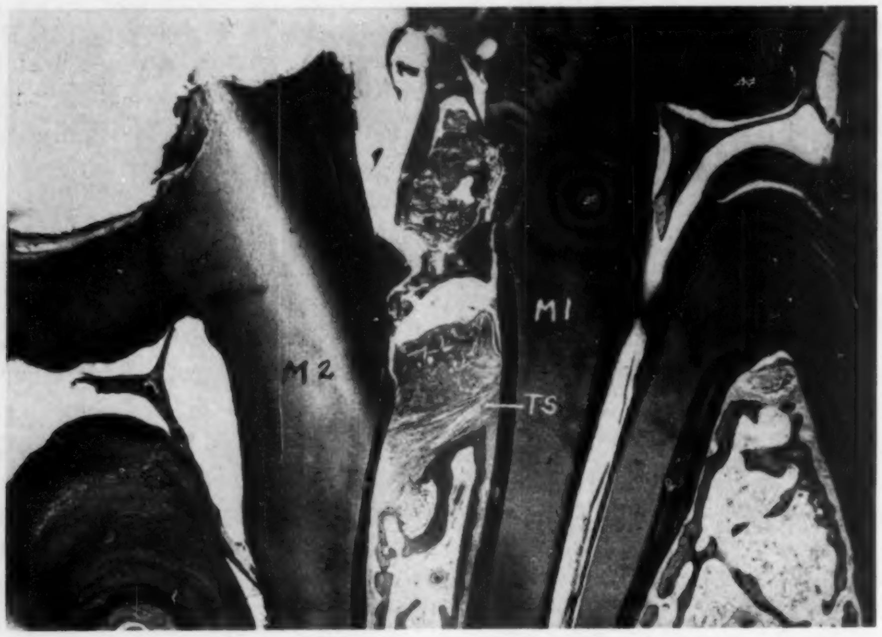


Fig. 1.—*M1*, Lower first molar; *M2*, lower second molar; *TS*, transeptal fibers.

Fig. 2.—*TS*, Transeptal fibers.

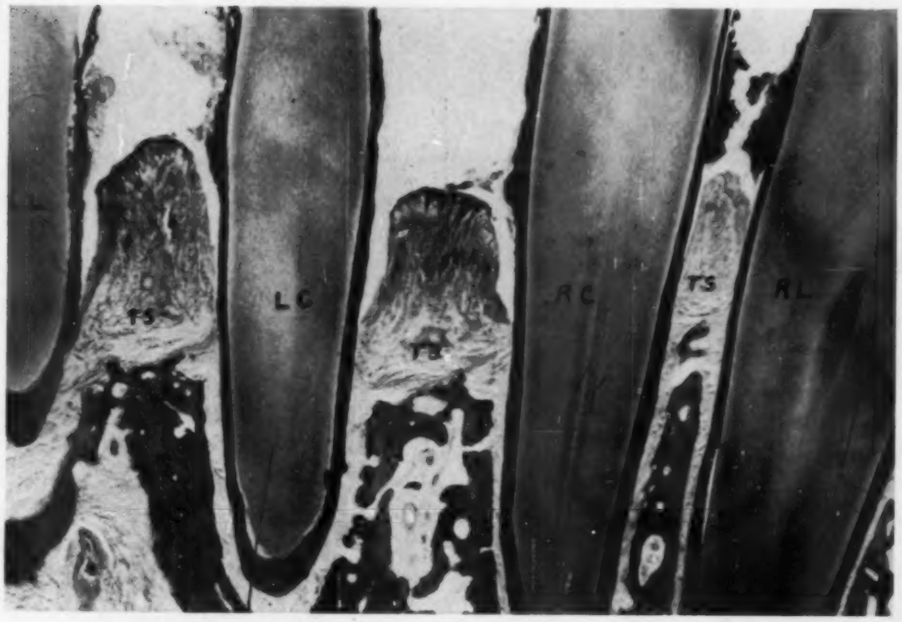


Fig. 3.—*LL*, Left lateral incisor; *LC*, left central incisor; *RC*, right central incisor; *RL*, right lateral incisor. *TS* labeling is just above the transeptal fibers.

Fig. 4.—*MR*, Molar root; *TS* labeling is just above the transeptal fibers.

Fig. 5.

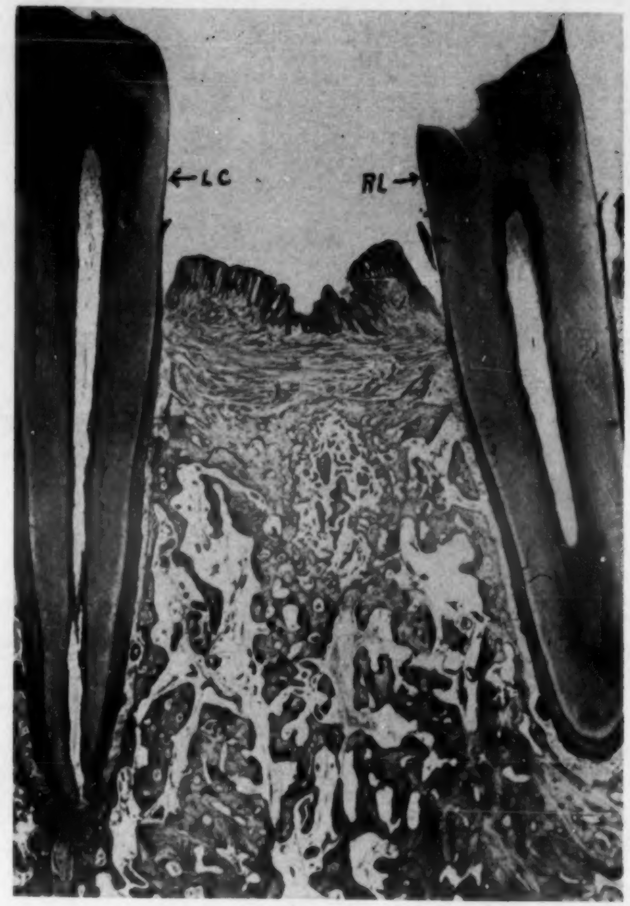


Fig. 6.

Fig. 5.—Low magnification of healed area from which the lower first molar had been removed. *P2* is the second premolar; *M2* is the second molar. The interdental papillae are still prominent. The transeptal fibers have fused with the scar over the extraction area. (Courtesy of Dr. J. Weinmann, Chicago.)

Fig. 6.—Low magnification of healed area from which the lower right central incisor had been removed. *LC* is the left central incisor; *RL* is the right lateral incisor. The interdental papillae are somewhat prominent. The transeptal fibers have fused with the scar over the extraction area. (Courtesy of Dr. J. Weinmann, Chicago.)

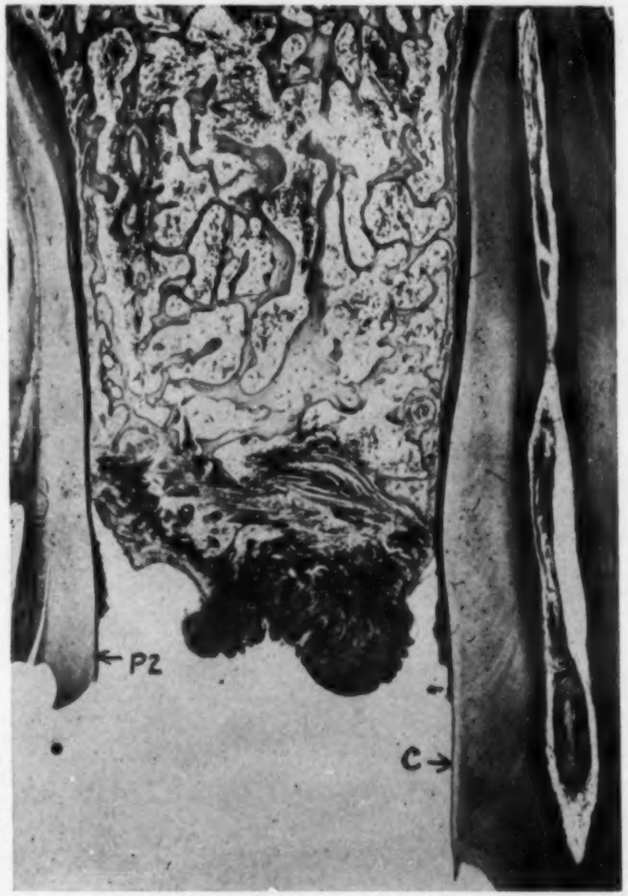


Fig. 7.

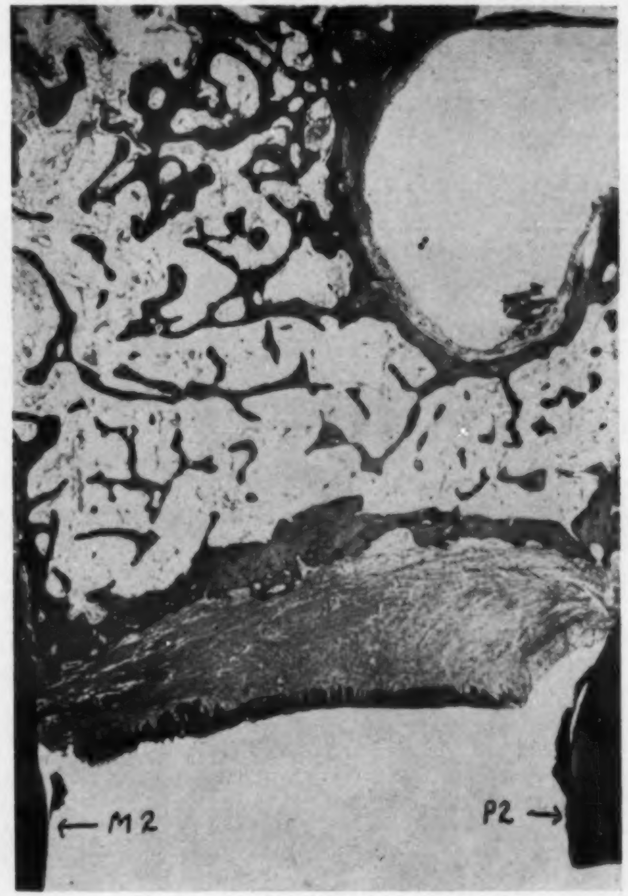


Fig. 8.

Fig. 7.—Low magnification of healed area from which the upper right first premolar had been removed. *C* is the canine, *P2* is the second premolar. The interdental papillae are still prominent. The transeptal fibers have fused with the scar over the extraction area. (Courtesy of Dr. J. Weinmann, Chicago.)

Fig. 8.—Low magnification of healed area from which the right upper first molar had been removed. *P2* is the second premolar, *M2* is the second molar. This is an older area of healing than Figs. 5, 6, and 7. The interdental papillae have disappeared but the transeptal fibers and scar are more dense. (Courtesy of Dr. J. Weinmann, Chicago.)

The mesial tipping of the crown caused a widening of the periodontal membrane at *A*. The bodily movement of the root crushed the periodontal membrane at *B*, which has since been completely repaired. The former elongated transeptal fiber group relaxed when it was forced to occupy a smaller area; it became coiled, irregular, and compressed. It was not removed or shortened.

A. *B.*

Fig. 9.—First patient, B. M. *A*, May 25, 1940; *B*, Feb. 12, 1942.

Fig. 10.—*C*, Canine; *P2*, second premolar; *TS*, transeptal fibers; *A*, area of widening of the periodontal membrane; *D*, resorption of alveolar crest of bone; *B* and *E*, crushing injuries of the periodontal membrane.

These fibers now resemble a mass of scar tissue. They caused pressure resorption of the alveolar bone at *D*, and also forced the alveolar bone *E* to crush the periodontal membrane against the root of the canine *C*. This area, similar to area *B* in the second premolar *P2*, has since completely repaired itself. The repair of these two crushing injuries to the peridontal membrane has been described by Gottlieb and Orban,[3] by Stuteville,[4] and by Oppenheim.[5]

It must be remembered that these teeth were retained in their positions with a fixed mechanical device. It is very likely that, once brought together, both teeth will become separated after removal of the mechanical retaining device because of the space required by the coiled and compressed transeptal fibers. This compression is the cause of relapse in such cases. It may also explain why teeth seldom drift completely together following the removal of intervening teeth.

Fig. 11 is a higher magnification of the interdental papilla shown in Fig. 10. The relaxed, coiled, and compressed transeptal fibers *TS* are clearly observed. Fig. 12 is the same area as Fig. 11, stained (Masson) to show the fibers, particularly at *A*. Here the alveolar crest fibers can be observed in the process of becoming part of the transeptal fibers. This process is shown again in Fig. 13, *A*, stained with silver (Wilder).

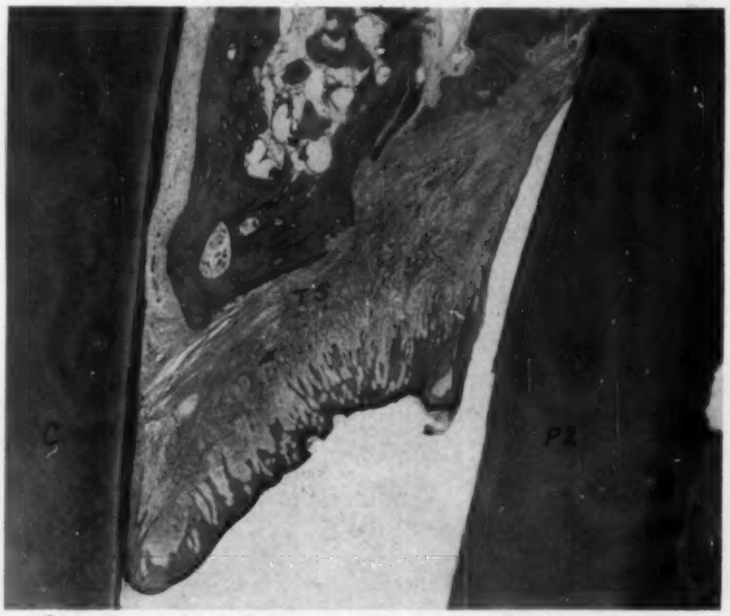


Fig. 11.—*C*, Canine; *P2*, second premolar; *TS*, transeptal fibers.

Fig. 14 shows "before and after" radiographs of the first patient, from whom the right lower first premolar had been removed. The second premolar was moved bodily for a distance of 4.5 mm. to take the place of the first premolar.

Fig. 15 is a low magnification of the entire block. The canine is shown at *C;* the premolar at *P2*. The coiled and compressed transeptal fibers are shown at *TS*. These teeth, after being approximated, were also retained by means of a fixed mechanical device. The space demanded by the compressed transeptal fibers forced the alveolar bone to separate at *B*. The coiled fibers now occupy this area as a scar. They prevented the reorganization of normal transeptal fibers. The "splitting" of the alveolar bone and the separation of the parts caused crushing injuries to the periodontal membranes of the canine at *D* and to the second premolar at *E*. It seems apparent that the compressed transeptal fibers by their very pressure prevented osteoclastic

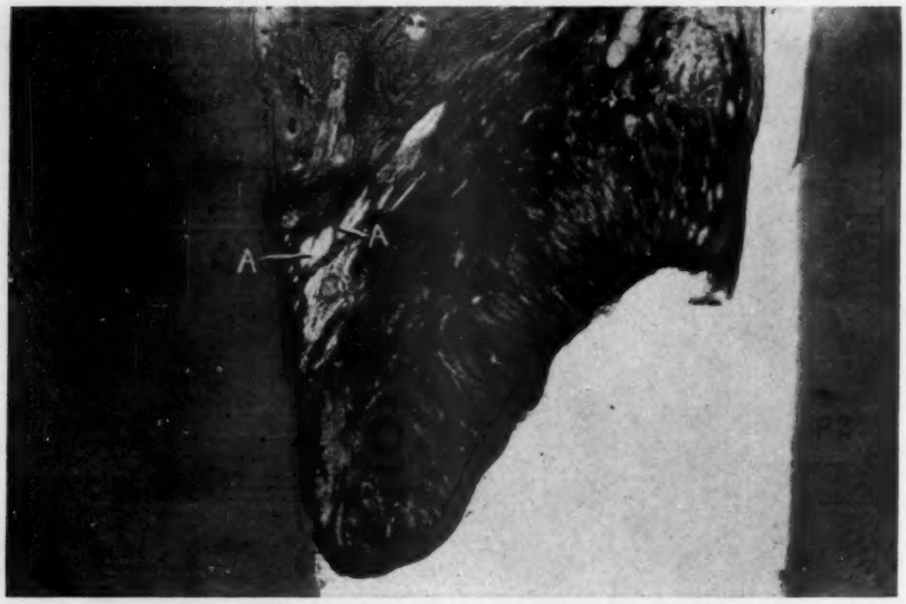


Fig. 12.—Masson stain. *C*, Canine; *P2*, second premolar; *A*, two areas showing alveolar crest fibers contributing to new transeptal fibers.

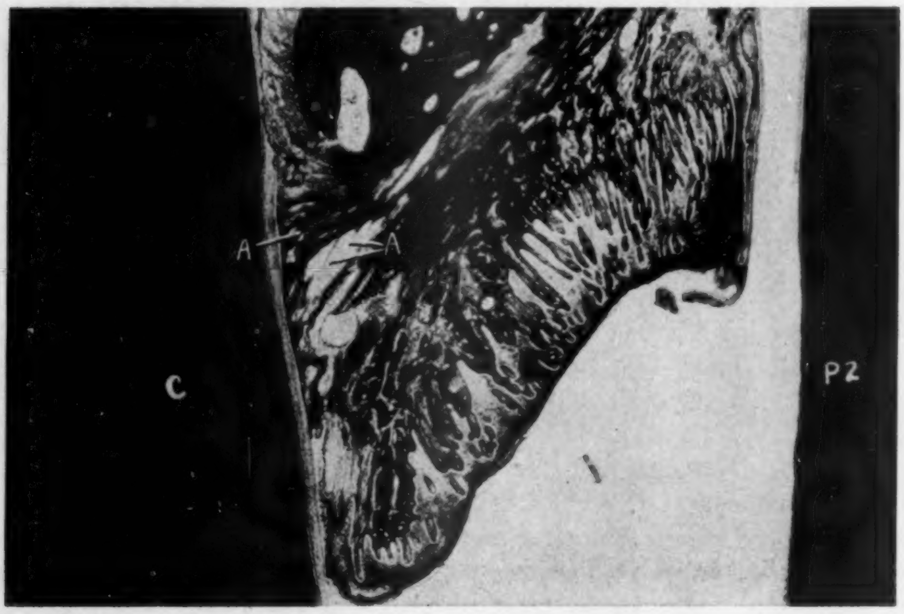
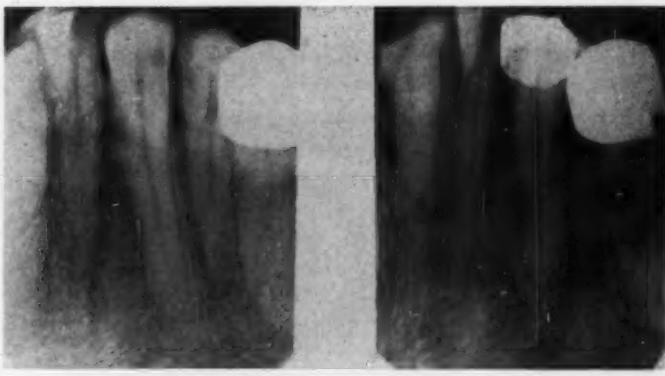


Fig. 13.—Wilder stain. *C*, Canine; *P2*, second premolar; *A*, two areas showing alveolar crest fibers contributing to new transeptal fibers.



A. *B.*

Fig. 14.—First patient, B. M. *A*, May 25, 1940; *B*, Feb. 12, 1942.

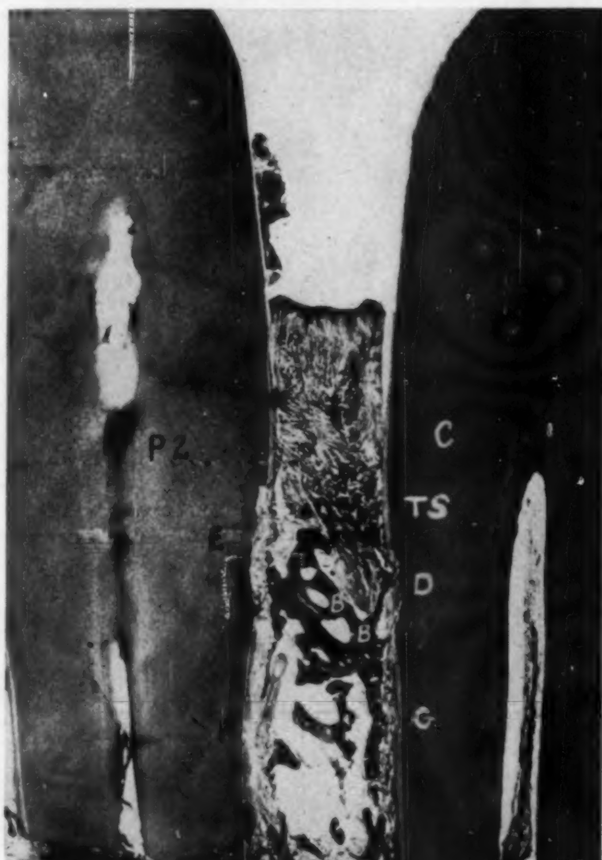


Fig. 15.—Wilder stain. *C*, Canine; *P2*, premolar; *TS*, compressed transeptal fibers; *B*, splitting of alveolar bone; *D* and *E*, large crushing injuries of the periodontal membrane; *F* and *G*, smaller crushing injuries of the periodontal membrane.

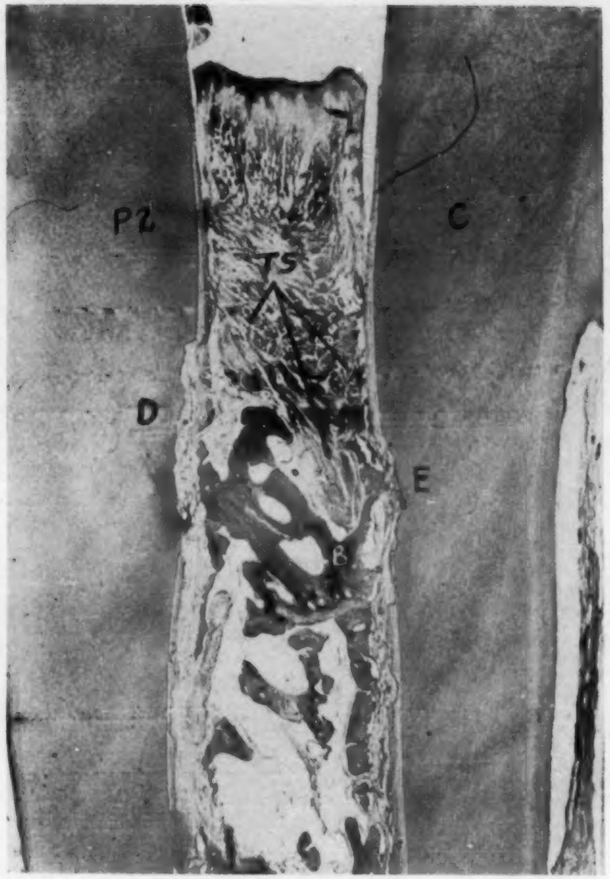


Fig. 16.

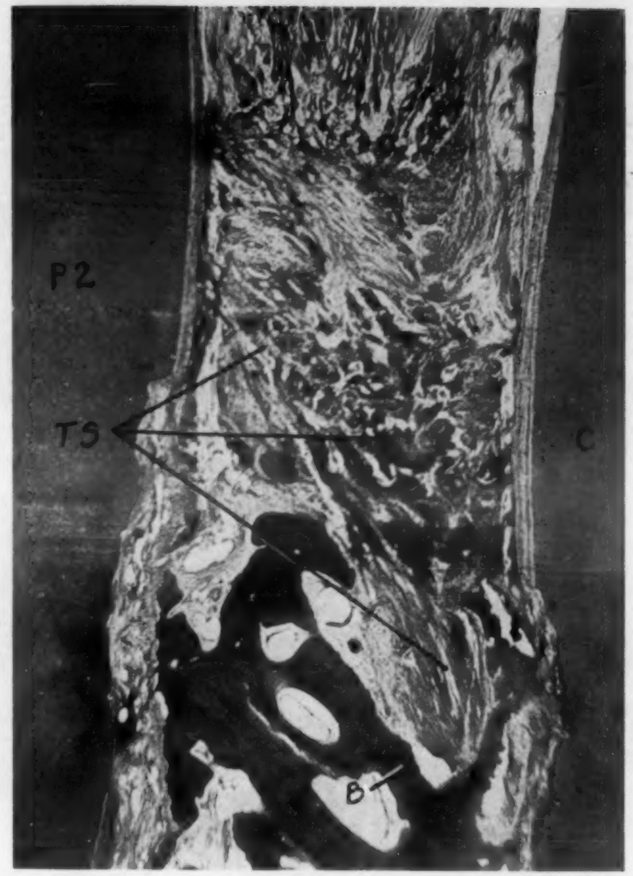


Fig. 17.

Fig. 16.—Higher magnification of Fig. 15. *C* is the canine, *P2* the second premolar. The coiled and compressed transeptal fibers can be seen at *TS*. *D* and *E* are crushing injuries to the periodontal membrane. *B* is where the alveolar bone has been split.

Fig. 17.—Wilder stain. *C*, Canine; *P2*, second premolar; *TS*, coiled and compressed transeptal fibers; *B*, splitting of the alveolar bone.

resorption of the crest of the alveolar bone, and caused a "splitting" before undermining resorption could become effective. Additional crushing injuries can be seen at *F* and *G*, which have since been repaired. The injuries involving the canine and premolar present excellent evidence that the behavior of these coiled transeptal fibers is similar to that of scar tissue. Apparently there is no physiologic process that shortens or removes the excess of fibers.

Fig. 18.—Same patient, B. M. Control.

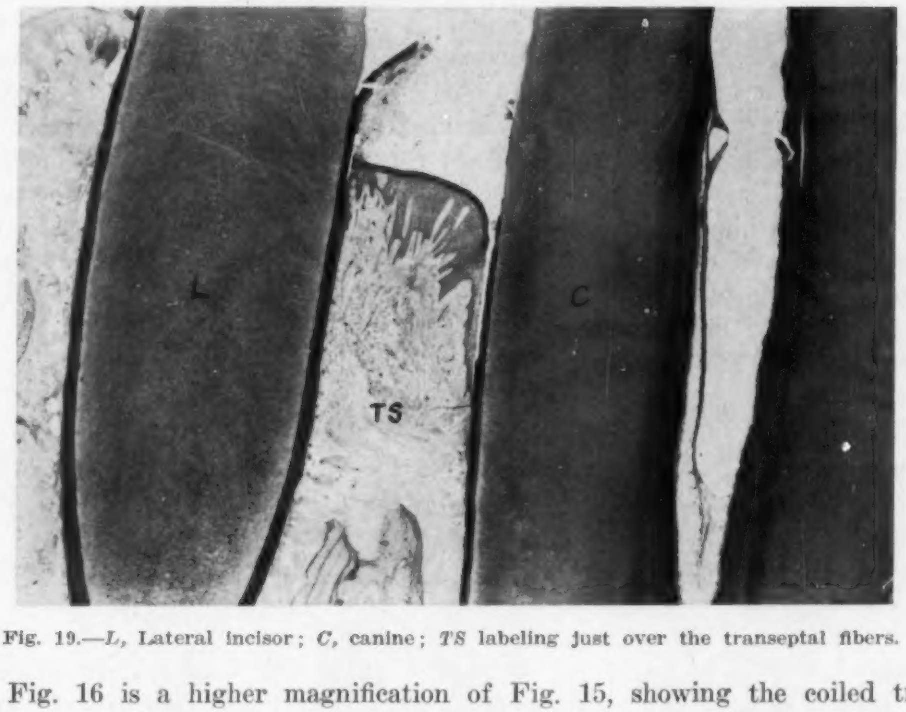


Fig. 19.—*L*, Lateral incisor; *C*, canine; *TS* labeling just over the transeptal fibers.

Fig. 16 is a higher magnification of Fig. 15, showing the coiled transeptal fibers. *TS*. The separation of the alveolar crest of bone is shown at *B*. The crushing injuries of the periodontal membrane and the resulting resorption of cementum and dentine of both the canine and premolar are seen at *D* and *E*.

Fig. 17 is a higher magnification of Fig. 16, stained with silver (Wilder), to show the character of the coiled and compressed transeptal fibers. They are dense, acellular, hyaline; they resemble scar tissue.

Even after two years the repair process is incomplete. There is evidense of pressure exerted upon the transeptal fibers that resulted in bone destruction and tooth resorption. It is probable that only fixed retention maintained these teeth in the position they now occupy. Relapse would most certainly have occurred if no retainer had been used.

Fig. 18 is a radiograph of the left lower canine and lateral incisor area of the same patient from whom the two blocks previously described were obtained (Figs. 9 to 17 inclusive). Fig. 19 is a low magnification of this block. This photograph is presented as a control. It demonstrates that despite the age of the patient and the loss of some of the alveolar bone due to gingival disease, the transeptal fibers show a nearly ideal arrangement. The teeth in this control were subjected to the same diet and function as those teeth used in the experiments.

Fig. 20 shows "before and after" radiographs of the second patient. The first premolar had been removed.

Fig. 21 is a low magnification of the block containing three teeth, the second premolar *P2,* the canine *C,* the lateral incisor *L.* As previously demonstrated, a compression of the transeptal fibers can be seen at *TS1.* A crushing injury to the periodontal membrane, since healed, is shown at *A.* The transeptal fibers *TS2,* between the canine and lateral incisor, are stretched; yet they retain their normal arrangement. It is apparent that transeptal fibers can withstand stretching to a degree, and yet carry the tooth to which they are attached in the direction of the pull. Stresses caused by tension may be the cause of hypercementosis on all the involved teeth.

Fig. 22 is a higher magnification of the papilla between the premolar and canine. The coiled fibers, stained with silver (Wilder), are shown at *TS1.* The crushing injury of the periodontal membrane and the resorption of cementum and dentine are shown at *A.* Healing of these areas is almost complete.

Fig. 23 is a higher magnification of the papilla between the canine and lateral incisor. The stretched transeptal fibers, stained with silver (Wilder), are shown at *TS2.*

Fig. 24 shows the transeptal fibers between the first molar and the second premolar. The molar was removed just prior to dissection of the block. The transeptal fibers *TS3* are stretched but intact, demonstrating their toughness.

Fig. 25 shows a "before and after" radiograph of the second patient.

Fig. 26 is a low magnification of the block containing three teeth. *P2* is the premolar, *C,* the canine, and *L* the lateral incisor. As previously demonstrated, we observe that the transeptal fibers *TS1* between the premolar and canine are coiled and compressed. On both the premolar and canine there are only minute crushing injuries, probably because these teeth were not brought so closely together as those in the other experiments. However, the transeptal fibers are coiled, with the resulting pressure resorption of the crest of the alveolar bone. At *TS2* we observe the stretched but well-arranged transeptal fibers between the canine and lateral incisor.

Fig. 27 is a higher magnification of the papilla between the premolar and canine. The coiled fibers can be seen at *TS1.*

Fig. 20.—Second patient, H. Upper radiographs, Jan. 16, 1941; lower radiographs, Sept. 26, 1942.

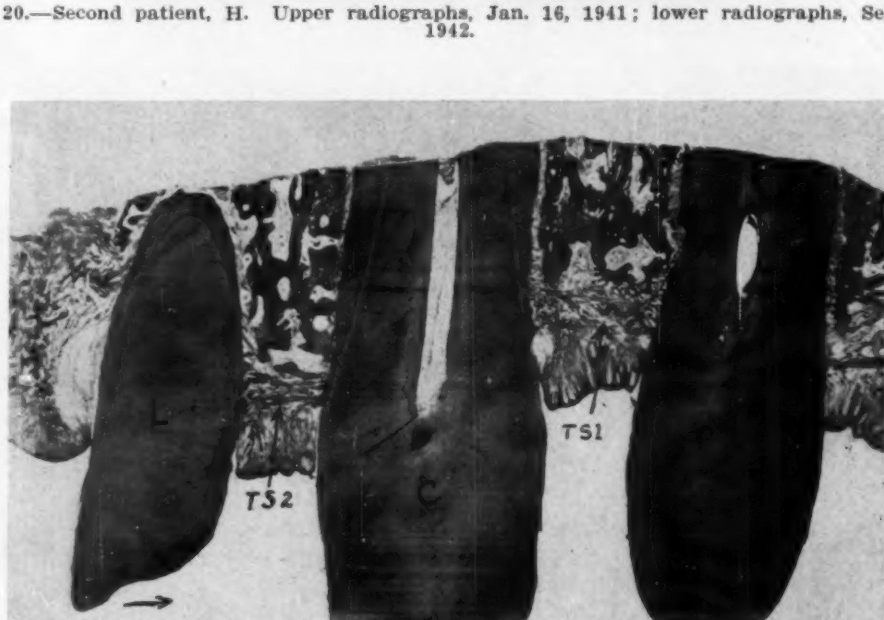


Fig. 21.—*L*, Lateral incisor; *C*, canine; *P2*. premolar; *TS1*, compressed transeptal fibers; *TS2*, stretched transeptal fibers; *A*, crushing injury to the periodontal membrane almost completely healed; arrows point out the direction in which the teeth moved.

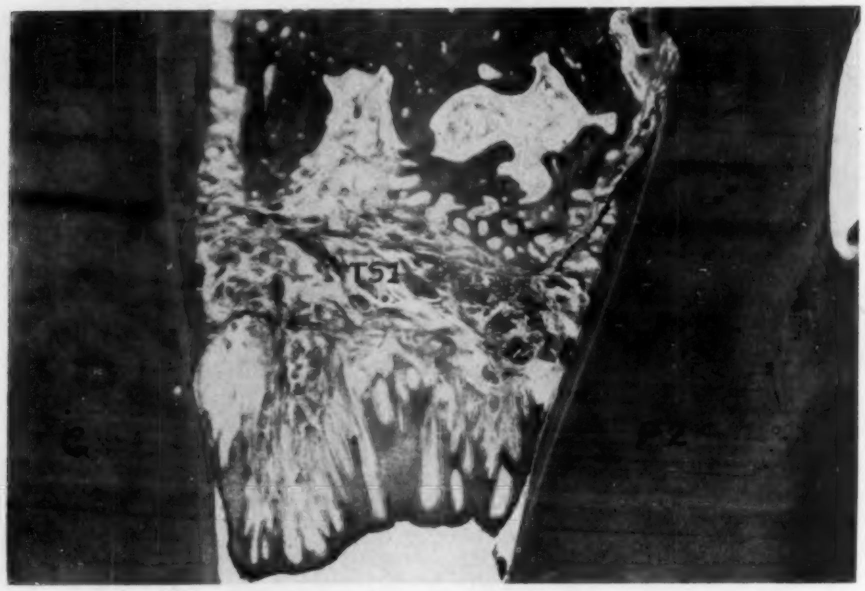


Fig. 22.—Wilder stain. *C*, Canine; *P2*, second premolar; *TS1*, compressed transeptal fibers; *A*, incompletely healed injury to the periodontal membrane.

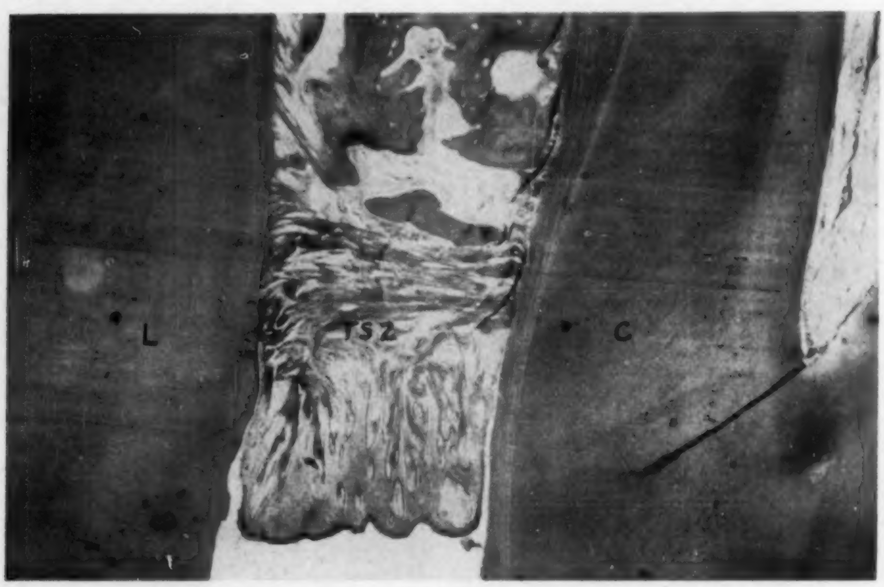


Fig. 23.—Wilder stain. *L*, Lateral incisor; *C*, canine; *TS2*, stretched transeptal fibers.

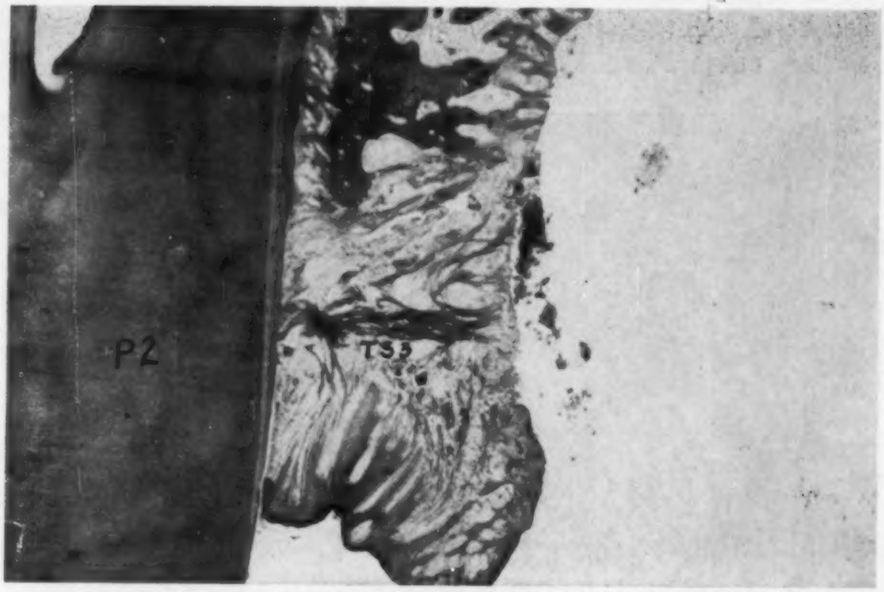


Fig. 24.—Wilder stain. *P2*, Second premolar; *TS3*, transeptal fibers remaining after removal of the first molar.

Fig. 25.—Second patient, H. Upper radiographs, Jan. 16, 1941; lower radiographs, Sept. 26, 1942.

Fig. 28 is a similar specimen, stained with silver (Wilder), to emphasize the coiled fibers. Minute crushing injuries, since repaired, can be observed on the premolar at *A* and on the canine at *B*.

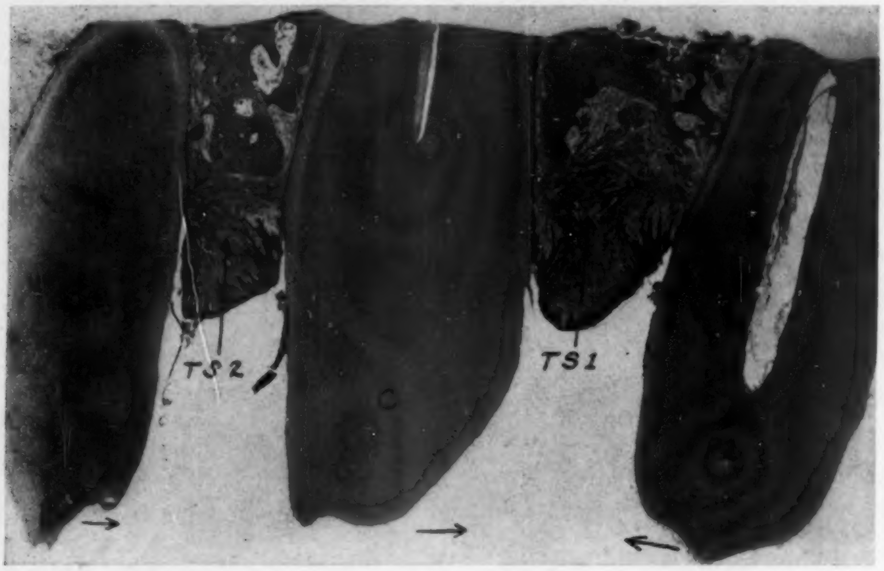


Fig. 26.—*L*, Lateral incisor; *C*, canine; *P2*, second premolar; *TS1*, compressed transeptal fibers; *TS2*, stretched fibers. Arrows point out the direction in which the teeth moved.

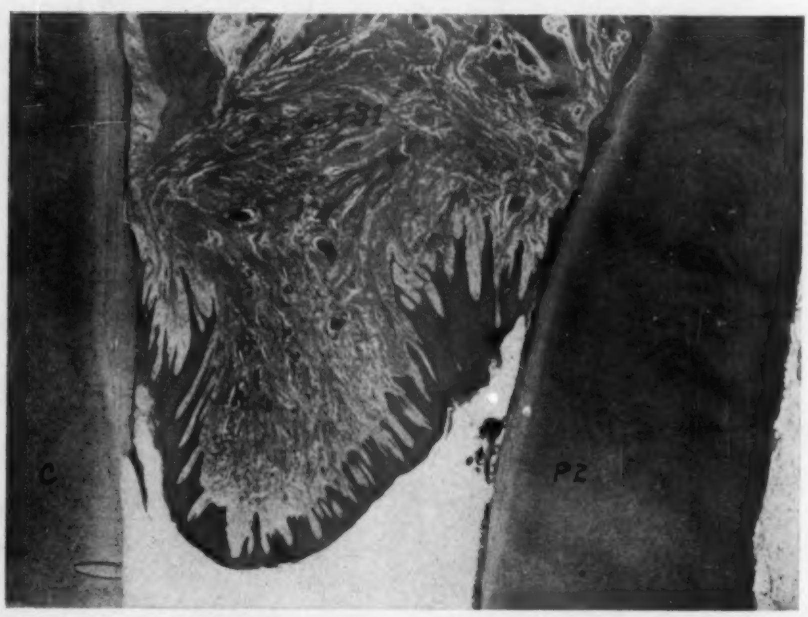


Fig. 27.—Hematoxylin and eosin stain. *C*, canine; *P2*, premolar; *TS1*, compressed transeptal fibers.

Fig. 29 is a higher magnification of the papilla between the canine and lateral incisor. The transpetal fibers *TS2* are stretched. The very fact that the cementum is thicker where these fibers are attached to both teeth indicates existing tension.

From the above experiments we may draw these conclusions:

1. Transeptal fibers are remarkably persistent, even when almost all bony support is lost.

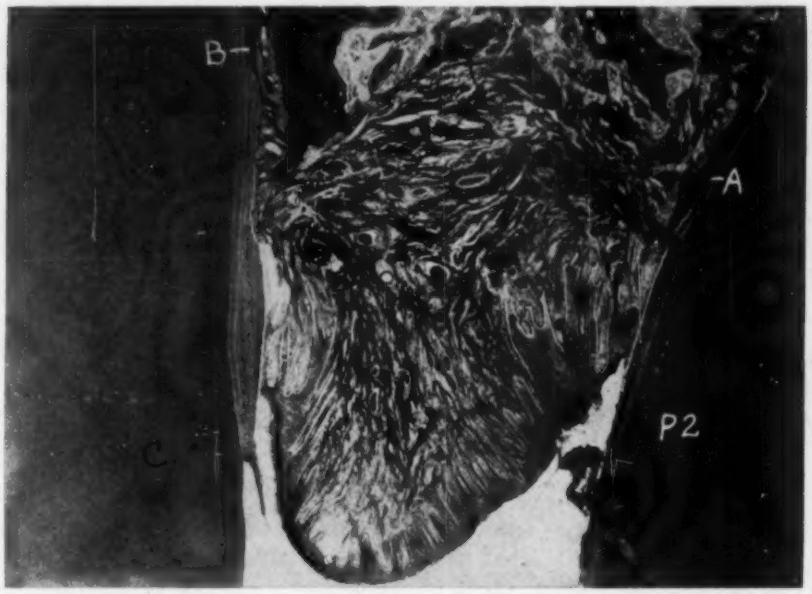


Fig. 28.—Wilder stain. *C*, Canine, *P2*, second premolar; *A* and *B*, areas of small injuries to the periodontal membrane since repaired.

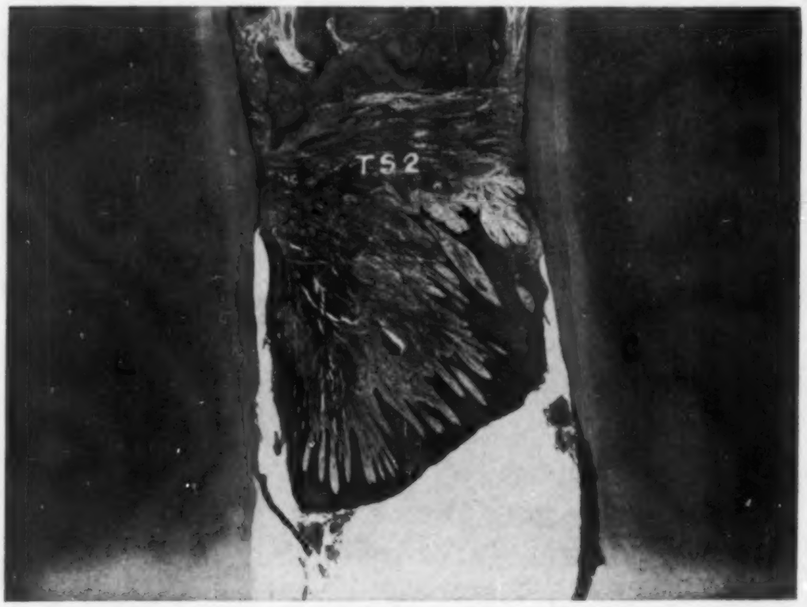


Fig. 29.—Hematoxylin and eosin stain. *L*, Lateral incisor; *C*, canine, *TS2*, stretched transeptal fibers.

2. Transeptal fibers are being continually renewed. Evidence is presented to suggest that the alveolar crest fibers, together with the matrix of disappearing alveolar bone, furnish these new groups of fibers.

3. Elongated transeptal fibers appear in the spaces created by tooth extraction.

4. When teeth opposite such spaces are brought into approximation by mechanical appliances, the transeptal fibers relax, coil, and then become compressed. They remain in the nature of scar tissue. It seems apparent that there exists no physiologic process which shortens or removes the excess of these fibers after the teeth are approximated. When the teeth are brought together, the compression of these scarlike fibers causes crushing injuries to the periodontal membrane and the alveolar bone. Resorption of bone, cementum, and dentine follows.

5. It is biologically unsound to expect good approximal contact to prevail between dental units after approximation through a space created by an extraction.

6. Possibly this explains why teeth fail to drift together completely after the removal of intervening teeth.

7. Evidence is offered to explain the tendency of approximal contacts to reopen after they have once been closed through a space created by an extraction.

8. Transeptal fibers are tough and can withstand some stretching. They pull the teeth to which they are attached in the direction of the force.

In carrying out this investigation, generous assistance has been extended us from many quarters, including the Army Medical Museum, the Baltimore College of Dental Surgery, Comdr. C. A. Schlack, D.C., U.S.N., Maj. M. W. McCrea, D.C., U.S.A., Lt. H. M. Goldman, D.C., U.S.A., Lt. L. Milobsky, D.C., U.S.A., Dr. Herman F. Bernstein, and Dr. E. Z. Aaronson.

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EXPERIMENTAL DEPRESSION OF TEETH

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DEPRESSION may be defined as the process of changing the relation of a tooth to the surrounding bone by causing its retrusion into the alveolus.

Clinically, it appears evident that teeth may be retruded in their alveoli by appliance therapy. The practice has been questioned by biologists. Gottlieb and Orban,[1] on the basis of extensive animal experimentation, described the phenomena associated with tooth movement. They showed that under changed physical conditions produced by appliance therapy, movement of the teeth occurred. When optimal, the essential changes occurred in the alveolus. Compression of the periodontal membrane caused resorption of alveolus and, under tension, apposition occurred.

An academic controversy arose over these principles. Depression of a tooth in its alveolus is accompanied by tension of all the periodontal fibers except those at the apex and bifurcation in multirooted teeth. Strict interpretation of the principles of tooth movement implies that tension of the periodontal membrane stimulates bone formation along the walls of the alveolus. Depression of a tooth in its alveolus is dependent upon resorption of the entire surface of the alveolus. If the clinical results are to be accepted, then resorption must occur under tension.

Proponents of the theory that a tooth cannot be retruded explained the apparent depression of a tooth on the basis of the continuous eruption of the remaining teeth. They contend that eruption can be arrested or retarded by appliance therapy, and the untreated teeth erupt. Clinically, the end result is similar to depression.

The literature on depression of teeth is meager and confusing. Hemley[2] mentions only one case out of twenty in which the anterior teeth were depressed after the use of bite plates. This finding was made on gross measurements. Histological examination of lower incisor teeth subjected to the intermittent stress of a bite plate showed no evidence of depression. Gottlieb and Orban[3] suggest that depression of teeth is possible and refers to resorption at the base of the alveolus. No mention is made of resorption along the walls of the alveolus which is essential to tooth depression. Mershon[4] believes that the use of a bite plate causes depression of the anterior teeth. Shields[5] recently reported on the depression of extruded teeth. His method permits the eruption of the untreated teeth.

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In discussion of the problem, one of the authors (L. M. W.) described a technique of appliance therapy which seemed to establish the possibility of tooth depression. The use of an appliance, in which normal articulation was maintained and an isolated tooth depressed, seemed to produce retrusion.

EXPERIMENTAL PROCEDURE

Appliances were made for two dogs which would subject various teeth to intermittent or continuous stress. Both animals were young, as measured by the lack of attrition of the anterior teeth.

The intermittent stress was produced by cementing crowns on the right upper and lower third premolars. The crowns were built above the occlusal level, thereby increasing the length of the clinical crown. The occlusal surface was prepared flat and at right angles to the long axis of the teeth. In this manner, the entire stress of mastication was applied to the crowned teeth providing intermittent stress.

On the opposite side a continuous stress was applied to the lower second premolars. Cast crowns were prepared for the three lower left premolars. The first and third premolar crowns were attached by a 0.036 inch gold alloy wire and served as an anchorage. A half-round tube was soldered to the crown of the second premolar in line with the long axis of the tooth. A 0.20 inch chrome alloy spring was doubled back upon itself and inserted into the tube to provide continuous stress upon the second premolar. The amount of stress was measured at 3 to 4 ounces of pressure. Two weeks later, the force was adjusted to the same pressure. One week following this date the spring became dislodged and there was no pressure on the tooth for a period of four days. Upon repair of the appliance, it was again adjusted to the previous force. Six days prior to the execution of the dog, the auxiliary spring was again broken so that the tooth was not subjected to any stress for this period. The appliance was in place for thirty-nine days, the stress for twenty-nine days.

In the second dog, single-rooted teeth were experimentally depressed without increasing the intermaxillary distance. Appliances were made for the left upper and right lower second incisors and right upper and left lower second premolars. The appliances were similar to those used for continuous stress in Animal 1 and a depressing force of 3 to 4 ounces was applied only at the time of insertion of the appliance. In order to maintain normal articulation, the opposing teeth were ground. Specimens were taken nineteen days later.

OBSERVATIONS

Gross or macroscopic observations were concerned with the continued eruption of the unexperimented teeth as measured by the changes in the intermaxillary distance in the anterior region of Animal 1. The cast metal crown was cemented on the upper right third premolar which opened the bite in the incisor region approximately 1 mm. Within one week the anterior teeth were in occlusal contact. At this time, the lower right third premolar was crowned, opening the bite 4 mm. in the anterior region.

Two weeks later, the opening between the anterior teeth was reduced to 3.2 mm. The experiment was terminated forty-nine days after cementation of the first crown. In the last two weeks of the experiment no further per-

ceptible closure of the bite could be measured. At this time the bite was open 2.5 mm. in the anterior region. Closure of the bite progressed more rapidly on the left side than on the right.

Fig. 1 is a photograph of the anterior teeth of the dog. The extent of bite opening is evident and is greater on the right than on the left side.

The relation between depression and eruption could not be measured. Clinical observations suggest that the depression was slight. The continuous active eruption was great.

The histological examination of the depressed teeth showed that they may be depressed in their alveoli. The same general phenomena was expressed in all cases. The periodontal membrane was under tension in that the fibers were stretched. On a horizontal plane, however, the thickness of the periodontal membrane was reduced. Under these conditions, resorption of the alveolar bone occurred.

Resorption progressed in isolated areas at different intervals. At no time were all the periodontal fibers unattached from the alveolar bone. The resorption progressed beyond the physiologic requirements of the periodontal membrane. Repair was followed by bone deposition along the fibers of the periodontal membrane imbedding them.

Fig. 2 is a photomicrograph of an upper right premolar of a dog which had been subjected to intermittent stress for forty-nine days.

The anatomy of the tooth requires consideration in analyzing the results. It is conceivable that compression of the periodontal membrane occurred on the surface of the root surfaces facing the interradicular septum. The proximal surfaces of the roots, i.e., the mesial surface of the mesial root and the distal surface of the distal root, demonstrate tension of the periodontal membrane. Resorption (*R*) is evident along these two surfaces although isolated areas appear normal. In areas where resorption has occurred, the thickness of the periodontal membrane increased markedly. Compression of the periodontal membrane may be observed at the bifurcation of the roots and apices. There is an increase in cancellous bone between the roots. The control tooth (left) shows evidence of eruption by bone formation (*BF*) along the entire alveolar process. The mandibular molar (Fig. 3) subjected to the same stress shows a similar result. Fig. 4 is a photomicrograph of the lower left premolar which has been subjected to a continuous stress. Examination of the surfaces subjected to tension shows that resorption has occurred along part of the alveolar bone exhibiting an increased thickness of the periodontal membrane. In some areas bone formation has occurred. Eruption of the control tooth may be measured by bone formation on the entire lamina dura.

The lamina dura in dogs is not continuous in the apical area. The bone changes in this region therefore are not as dramatic as in other areas. In multirooted teeth, the results at the apices and in the bifurcation are similar. Fig. 5 is a higher magnification of the bifurcation of the lower molar shown in Fig. 3. The periodontal membrane is compressed and shows an abundance of blood vessels *(B.V.)*. There is no orientation to the periodontal fibers. Resorption of the alveolar bone is severe. Resorption of the cementum extending into the dentine is marked.

Fig. 1.—Anterior view of Animal 1, forty-nine days after bite opening. No closure perceptible during last fourteen days. Closure greater on left side, demonstrating alteration of temporomandibular articulation.

Fig. 2.—Depressed upper premolar of Animal 1, intermittent stress. Note tension of periodontal membrane on mesial surface of mesial root and distal surface of distal root. Increased thickness of periodontal membrane in area of resorption (*R*). Unresorbed alveolar bone (*UR*). Bone formation (*BF*) at bifurcation of control (left) indicates eruption.

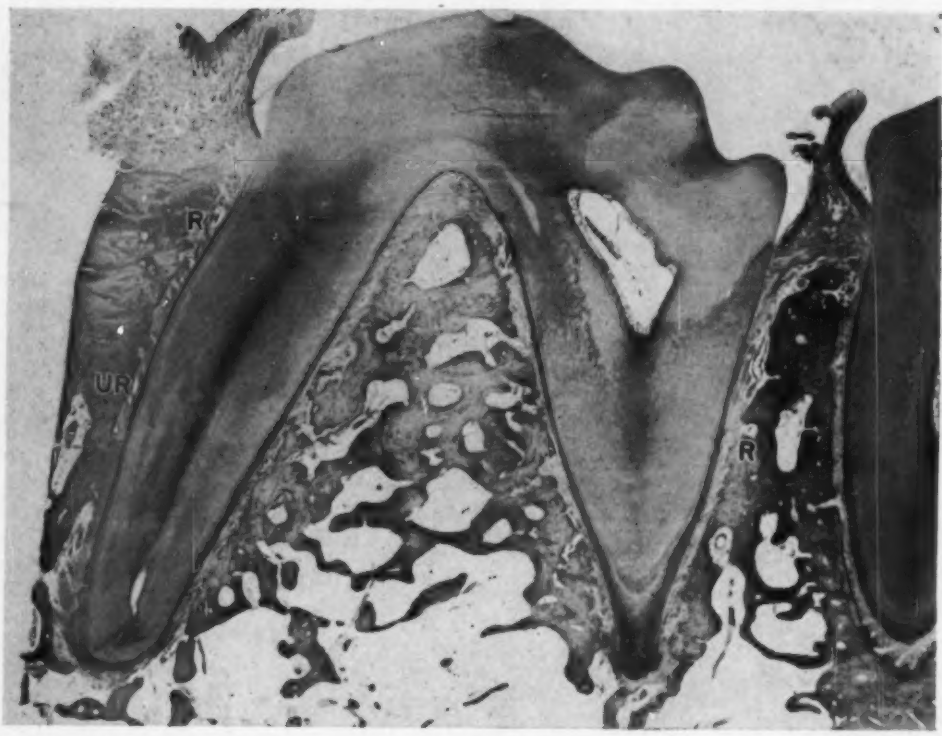

Fig. 3.—Depressed lower premolar of Animal 1, intermittent stress. Note tension of periodontal membrane on mesial surface of mesial root and distal surface of distal root. Increased thickness of periodontal membrane in areas of resorption (*R*). Unresorbed alveolar bone (*UR*).

Fig. 4.—Depressed lower premolar of Animal 1, continuous stress. No stress applied for last six days. Resorption (*R*). Eruption of control (left) indicated by bone formation (*BF*) at bifurcation.

demonstrates the same bone change as found in other areas of resorption. The periodontal membrane is compressed and shows a profuse blood supply. Large Howship's lacunae are present in the alveolus, and the resorption involves the Haversian bone. The cementum shows no resorption in contrast to the specimen subjected to intermittent stress (Fig. 5).

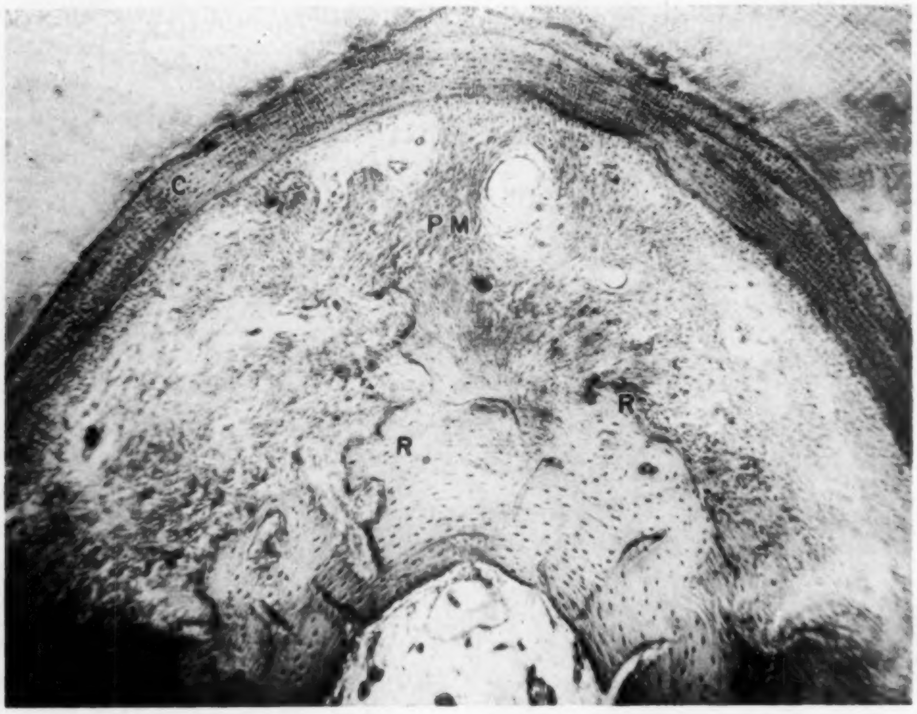

Fig. 8.—Bifurcation of roots of tooth shown in Fig. 4. Periodontal membrane (*PM*) shows increased vascularity and loss of orientation of principal fibers. Resorption (*R*) of alveolar bone. Cementum (*C*) normal.

Fig. 9 is an area taken from the middle third of the root shown in Fig. 4, demonstrating the intermittent process of resorption and repair. At *R* the process of resorption is arrested. The circumferential bone had not been completely resorbed. The extent of the resorbed area is evident. A thin layer of new bone had formed on this surface. The blood supply in this area is greater than in the normal area (*N*) and less than that found in areas of active resorption (*R*). At *N* a small area of the original lamina dura may be seen showing no resorption of this surface. The periodontal membrane supplying area *N* exhibits very little blood supply. Undermining resorption is occurring from above and below where there is an abundant blood supply. At *R* active resorption is in progress with osteoclasts present and a profuse blood supply. The thickness of the periodontal membrane varies in all three areas.

The control teeth taken for Animal 1 showed evidence of eruption. Fig. 10 is a photograph of the bifurcation of a lower molar. The periodontal membrane has a uniform thickness, and orientation of the fibers is normal. Bone formation (*BF*) is evidence that eruption occurred. A similar result may be observed along the middle third of the root (Fig. 11). The increased formation of bone and cementum may be seen.

In Animal 2 the articulation was not disturbed. Four single-rooted teeth were depressed. The results were similar in all cases. Fig. 12 demonstrates the result of one application of a depressing stress to a single-rooted tooth. Resorption (*R*) had occurred along the entire lamina dura. Repair (*RE*) and reattachment of the periodontal fibers to the alveolar bone may be noted in isolated areas. Where resorption is still active, the periodontal membrane is much thicker than in the repaired zones.

Fig. 9.—Middle third of root of tooth shown in Fig. 5. Beginning repair (*RE*) by new bone formation. Normal unresorbed surface of lamina dura (*N*). Area of active alveolar resorption (*R*). Note variations in thickness of periodontal membrane (*PM*). Blood supply at *RE* moderate, at *R* abundant, at *N* minimal.

Under higher magnification, three different phenomena associated with tooth movement may be graphically described. A higher magnification of resorption of alveolar bone may be seen in Fig. 13. Here it will be seen that the thickness of the periodontal membrane is greatly increased. Both the fibrous attachment to the cementum and the blood supply approximating the cementum is normal. In the area of the alveolar bone, resorption is in progress demonstrated

by the presence of Howship's lacunae and osteoclasts. The periodontal membrane is not attached to the bone by Sharpey's fibers, and, approximating the lamina dura, exhibits a marked hyperemia almost to the point of hemorrhage.

Fig. 14 demonstrates an early stage of repair. The circumferential bone has been entirely resorbed as well as some of the Haversian bone. A thin layer of new bone has formed on the resorbed surface of the lamina dura. The continuous layer of osteoblasts (O) seen on the surface is evidence of bone formation. The periodontal membrane is markedly increased in thickness and although one very large blood vessel is present, there is a general reduction in the blood supply to this area as compared to Fig. 13.

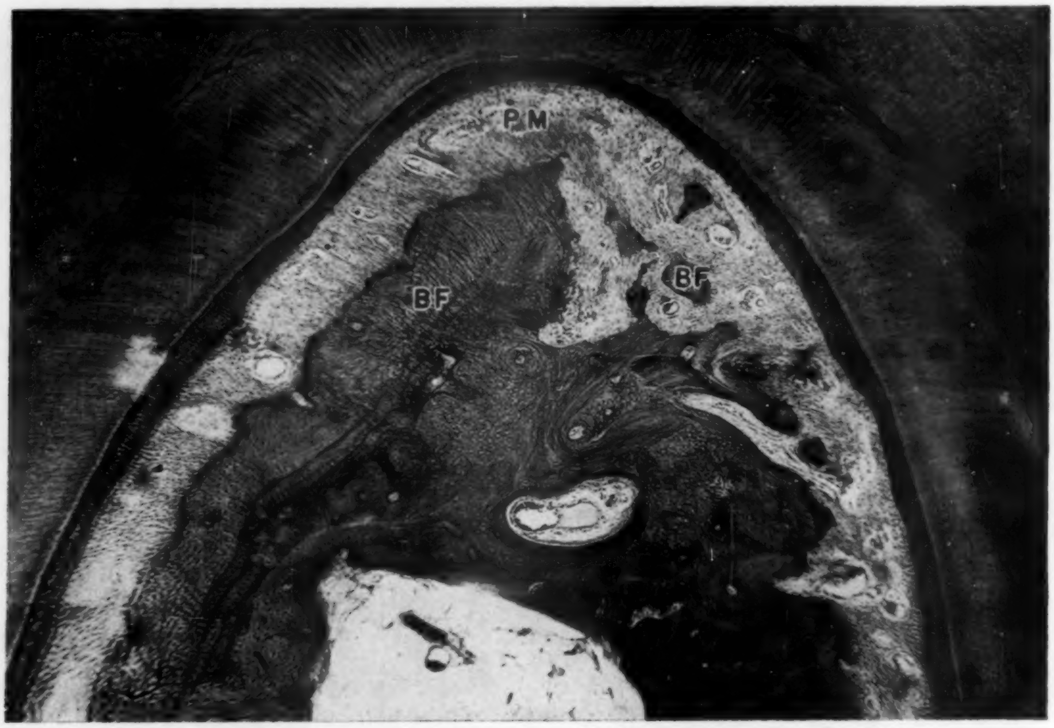

Fig. 10.—Bifurcation of control tooth of Animal 1. Normal periodontal membrane (*PM*). Bone formation (*BF*) indicates eruption.

Fig. 15 shows a state of complete repair. The formation of a layer of circumferential bone into which the periodontal fibers are embedded may be observed. The periodontal membrane has been reduced to its physiologic thickness and the blood supply is again minimal. The principal fibers have again assumed their normal directional orientation. The cementum is normal.

DISCUSSION

The application of a stress in the exact direction of the long axis of a tooth is difficult to achieve. It is conceivable that slight deviation may have occurred. However, the techniques of experiment were similar to those used clinically, and macroscopic observations indicated that tooth depression occurred. Any deviation from the true axial stress would be accompanied by compression of the

periodontal membrane on the walls of the root. Histologically this occurred only at the bifurcation of multirooted teeth and at the apices of all experimented teeth.

An evaluation of the results of the experimental tooth depression is clearly intelligible if the function of the periodontal membrane is taken into consideration. Briefly stated, its fibers serve to attach the cementum to the alveolar bone and resist stresses applied to the teeth. The periodontal membrane forms cementum and may either cause bone formation on the surface of the lamina dura or resorb it. These functions were all demonstrated in this experiment.

Fig. 11.—Middle third root control tooth of Animal 1. Bone formation (*BF*) indicating eruption. Note increased thickness of cementum (*C*).

Investigators[1, 6] in this field expressed the opinion that a physical condition of the periodontal fibers was responsible for the resorption and formation of bone. This concept was based on the results of the application of a lateral stress to the crown of a tooth which caused tilting. Thus, where the fibers were stretched (tension), bone formation occurred. This explanation was offered as

Fig. 12.

Fig. 13.

Fig. 12.—Depressed anterior tooth of Animal 2. Resorption, *R*. Repair, *RE*. Note increased thickness of periodontal membrane (*PM*) in area of active resorption, and reduction in areas of repair.

Fig. 13.—Area *1* of Fig. 12. Periodontal membrane (*PM*) on cemental side normal. Cementum (*C*) normal. Alveolar bone shows extensive resorption (*R*) with osteoclasts. Periodontal membrane on alveolar bone side exhibits extensive hyperemia. Periodontal membrane disattached from alveolar bone. No Sharpey's fibers present.

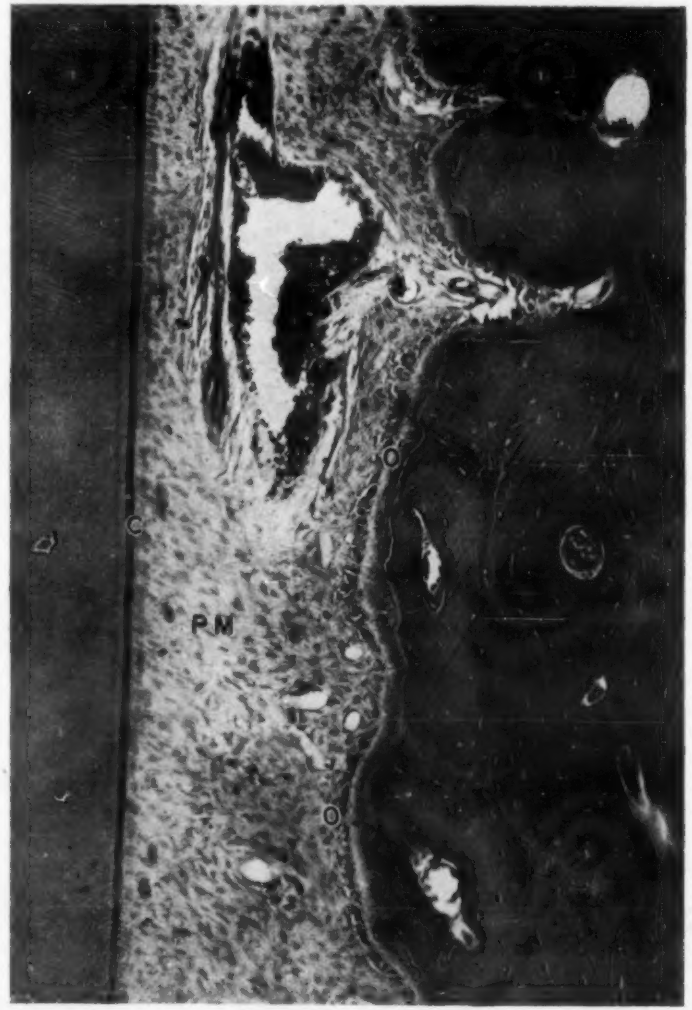

Fig. 14.

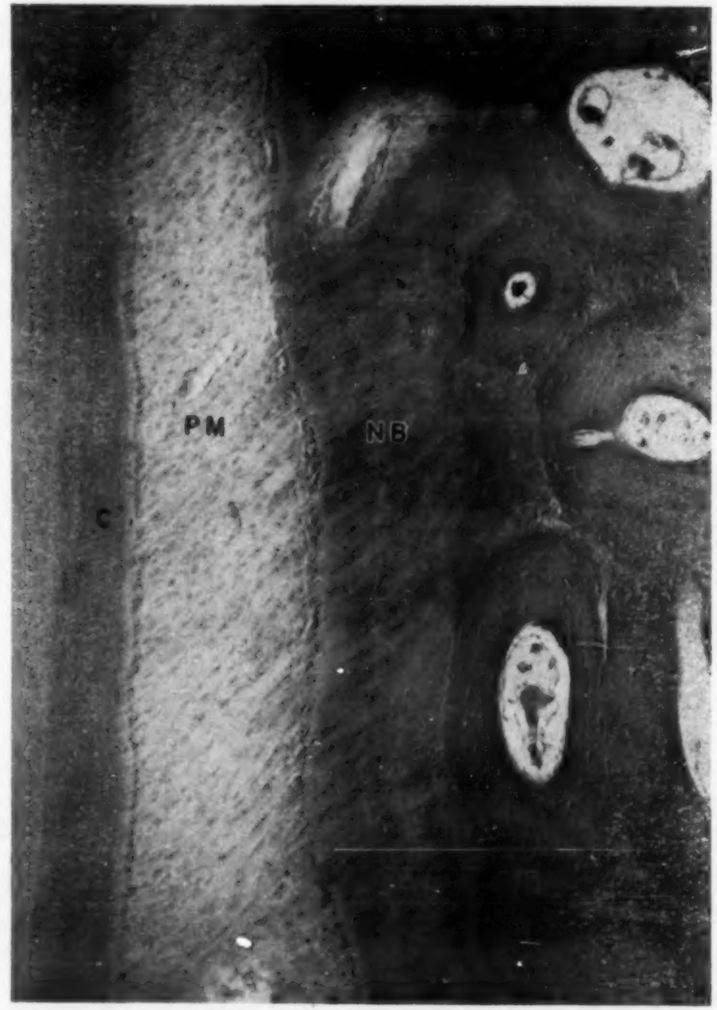

Fig. 15.

Fig. 14.—Area *2* of Fig. 12 showing beginning repair. Resorption extended into Haversian bone. Bone formation is evident by layer of osteoblasts (*O*) on surface of alveolus. No Sharpey's fibers in original alveolus. New fibers are being imbedded into new bone. Periodontal membrane, *PM*. Cementum, *C*.

Fig. 15.—Area *3* of Fig. 12. Complete repair (*NB*), new bone formation with Sharpey's fibers provide reattachment. Periodontal membrane (*PM*) reduced to physiologic thickness, blood supply minimal. Normal cementum, *C*.

the sole cause of bone formation. Other phenomena were disregarded. Where tension occurred, there was an increased thickness of the periodontal membrane. No cognizance was taken of the blood supply in this area. In the area where pressure (compression) of the periodontal membrane occurred, resorption of the lamina dura followed. When under pressure, the area normally occupied by the periodontal membrane is narrowed. The blood supply was completely eliminated under excessive pressure. The blood vessels were occluded and necrosis occurred.

The results of experimental tooth depression contribute further to the knowledge of the function of the paradentium. The periodontal membrane is stretched (tension) along the walls of the roots and compressed at the bifurcation and apices during tooth depression. The area normally occupied by the membrane along the walls of the roots becomes narrower as a result of the stress. The periodontal fibers attach the cementum to the bone at a more acute angle. The periodontal membrane seeks to restore its physiologic thickness, which is generally accomplished at the expense of the lamina dura. Resorption of its surface severs the fibrous attachment to the alveolar bone (Figs. 6 and 13). Were this to occur on the entire surface of the lamina dura simultaneously, there would be no fibrous attachment and the tooth would become exceedingly loose. However, the process occurs only in isolated areas; consequently, there is always some unresorbed bone with a fibrous attachment (Figs. 7, 8, 14, and 15). A similar process occurs during the physiologic resorption of deciduous tooth roots.

Resorption of the lamina dura progresses beyond the needs for the physiologic thickness of the periodontal membrane (Figs. 7, 14, and 15). The formation of bone continues until the periodontal membrane reaches its physiologic thickness (Fig. 15). After reattachment of the periodontal membrane to the lamina dura occurs, other areas of the alveolar bone undergo the same changes. This mechanism provides areas of periodontal attachment during the process of tooth depression.

Resorption of the surface of alveolar bone or cementum disattaches the periodontal membrane from the area. Repair of resorbed areas requires the embedding of connective tissue fibers into the newly formed osteoid tissue which later becomes calcified. The fibrous attachment to the cementum was unaffected except for the bifurcation areas under intermittent stress (Fig. 5).

The findings seem to justify an altered concept of bone changes during orthodontic treatment. Rather than base the bone changes on a physical state of the periodontal membrane (tension, compression) the need for establishment of the physiologic thickness of the periodontal membrane seems of paramount importance.

For practical purposes the continuous depressing stress provided only the last six days for repair. Thus the periodontal membrane had little opportunity to resist the constantly applied stress and establish a physiologic thickness. In Animal 2 the balance between the periodontal membrane and applied stress was possible. In this case the depressing force was applied once at the beginning of the experiment. As the tooth moved into its alveolus, a state of balance was established between the constantly reduced force and the periodontal membrane. Here one can observe the return of the periodontal membrane to its physiologic

thickness (Fig. 15). It is apparent that, regardless of pressure or tension, the important factor is that the periodontal membrane seeks to establish its physiologic thickness which is generally made possible by bone changes.

The blood supply to the area appears to be significant. Where resorption occurs, the blood supply is profuse. In areas where resorption is retarded or repair occurred, the blood supply is minimal. In the event of excessive compression, the blood supply to the periodontal membrane is obliterated and no resorption can occur. Grieg[7] expresses the relationship of blood supply to bone in a similar manner. He states:

"1. Maintain the circulation within certain limits and bone remains unchanged.

"2. Produce a definite hyperemia and bone undergoes rarefaction, decalcification, osteoporosis.

"3. Restrict the blood supply and bone undergoes density and osteosclerosis.

"4. Cut off the blood supply and bone undergoes necrosis."

The same principles apply to the resorption and formation of bone during tooth movement.

A comparison of the effect of two different types of stress are clearly expressed in the histological examination. The intermittent stress was produced by elevating the occlusal surface so that the entire stress of the masticatory apparatus was withstood by one tooth in each jaw. Resorption of the cementum and dentine occurred in both upper and lower tooth. This was observed only in the area of the bifurcation (Fig. 5) where the periodontal membrane was compressed. No resorption was observed on other areas of the root. In contrast, no resorption was noted following the use of a continuous stress (Fig. 9).

This finding suggests that the paradentium tolerates a continuous stress of 3 to 4 ounces better than an intermittent one caused by the stress of mastication. No evidence of periodontoclasia was observed in any case.

In Animal 1 the continuous eruption of the anterior teeth was measured. The rate of eruption was most rapid immediately after bite opening and declined with time. The eruption appears to arrest itself eventually. Speidel[8] reported a similar observation in humans. Further experimentation on this subject is in progress.

The closure of the bite on the left side of Animal 1 was greater than on the right. Inasmuch as the occlusal level of the experimental teeth was raised on the right side, it is likely that the change occurred in the temporomandibular articulation.

SUMMARY AND CONCLUSIONS

1. Teeth may be depressed in their alveoli.

2. As a result of appliance therapy, the periodontal membrane seeks to establish its physiologic thickness by bone changes in the lamina dura.

3. Bone resorption is accompanied by an increased vascularity of the periodontal membrane.

4. Resorption occurs under tension of the periodontal fibers. It extends beyond the physiologic thickness of the periodontal membrane so that new fibers may be embedded in the newly formed bone during repair.

5. During tooth depression, the entire surface of the lamina dura is not resorbed simultaneously. It occurs intermittently in isolated areas so that the entire periodontal membrane is not severed at one time.

6. The findings suggest that a mild *continuous* stress is better tolerated by the paradentium. Under an intermittent stress, resorption of cementum and dentine occurred.

7. The rate of continuous active eruption is most rapid immediately after bite opening, declining with time and eventually being arrested.

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AN APPROACH TO THE TREATMENT OF MALOCCLUSION, MORE PARTICULARLY CLASS II, DIVISION 1 (ANGLE), USING THE UNIVERSAL TECHNIQUE OF DR. SPENCER R. ATKINSON

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During the past ten years orthodontics has made rapid strides, principally due to the research carried on in our field by many competent investigators. More especially would I mention the work of Atkinson, Brodie, Broadbent, Tweed, Johnson, and Hellman. There are many others worthy of recognition. I do not by any means wish to omit them or leave them out of the picture even though they are not mentioned here. To do so would be beyond the scope or intent of this paper. The literature is replete with the writings of others which reveal to us in a clear concise manner the best thought of our specialty. To me it represents work and effort through which we are given information of great value. I now wish to acknowledge my appreciation and thanks for all of the opinions and real helpfulness I have gained through the study of the very fine articles published from time to time. May I suggest that you review them? If you do, you will be well paid for your effort.

Today is truly an age of progress. Scientific thought is in a state of flux. Things apparently true today may be disproved or changed tomorrow. In every undertaking, and more particularly in our field, we must, for compelling reasons, keep an open mind so that all that is new may aid us in the accomplishment of the common tasks which confront us daily. Our theory and approach to treatment, if we are to solve our problems, leads us to the conclusion that our deductions must be basically sound if we are to keep up with the rapid changes.

In the field of aviation, chemistry, metallurgy, in fact, in all of the basic sciences which affect and concern human economy—more particularly I mention medicine and surgery, together with orthodontics—much progress has been observed. In aviation, planes are now being constructed without propellers; in medicine, new therapeutic agents have been discovered and perfected, notably blood plasma, penicillin, and the sulfonamides; new anesthetics are used in surgery, together with the development of electrosurgery which is now recognized as an adjunct in our field for the removal of hypertrophied gum tissue covering the lower third molar, as well as exposing unerupted maxillary canines. I have used this in my practice with great success.

Within the past few years metallurgical science has provided a new material with which to do our work. Through its use, it is possible to reorient our mode of procedure by the application of a new technique to apply well-known principles. Under the impetus to find some material other than gold alloy for our appliance construction, the metallurgist has devedoped and furnished us chrome steel. For the material to make retainers and bite plates our thanks must go to chemical research. Acrylics are in vogue now instead of vulcanite. Truly, accomplishments of this character must be considered a

Read before the New York Society of Orthodontists, March 7, 1944.

step forward. Chrome steel has great strength, is noncorrosive in the fluids of the mouth, and has a good color. The ease in which it may be fabricated makes it a worthy adjunct to our technique. Its elasticity, even when drawn into wire, both ribbon and round, to dimensions of 0.008 to 0.012 is truly amazing. Furthermore, by the employment of these delicate wires in the actual movement of teeth, one will observe they are apparently more physiologic in action, and certainly more comfortable to the patient, than wires of heavier dimensions used principally in gold alloys. My experience with light chrome steel wire persuades me to believe that the various types of malocclusion respond more favorably and more readily to treatment. Band material of chrome steel surpasses many times in edge strength that of gold alloy. It is rare indeed for the band to fail when it is properly constructed. The bands, on account of their great edge strength, have no tendency to pull away from the teeth. In my clinic, I shall attempt to show you a method of forming bands easily for any type of tooth. In addition to the foregoing, after using this material for five years it has been my observation that the mouths of my patients are cleaner than they were during the twelve-year period that I used gold alloy. Food and stain does not seem to adhere to chrome steel as it does to gold alloy; consequently, this is reflected in the healthful condition of the gingival tissue. I do not attribute this healthful appearance entirely to the use of chrome bands, but also to the effect of the delicate steel wires used in the movement of teeth. Apparently the laws of physiology are, in a sense, more in keeping with the demands of cell metabolism. The force is gentle and continuous; the patient hardly knows it is present.

Since this new material has been developed and lends itself admirably to our purpose, it occurs to me that we are in a better position to improve our orthodontic procedure than heretofore. At the present time I know of no metal which provides greater durability and safety, nor one which is so easily fabricated. Certainly one's work at the chair may be accomplished more quickly by welding than by soldering all of the necessary parts of an appliance. Then, too, by the elimination of soldering we retain the original temper of our wire and band metal—truly an element of no small importance.

Now this brings me to a discussion of the universal appliance, which I have employed in my practice for the past five years with few minor exceptions. As you know, it was given to the profession by Dr. Spencer R. Atkinson of California. By its use and the application of the principles which he has interpreted in his theory of treatment, it offers, to me, the most realistic approach and the best hope of achievement of success in the treatment of malocclusion. Parenthetically, I should like to say here for the benefit of all, I am not, through inference or otherwise, in any way casting the least bit of disparagement on the method, opinion, or work of others. My purpose is only to confirm and outline to you in a general way my reaction, opinion, and experience with the universal appliance. I recognize, as you do, that there are many other excellent appliances and methods of treatment. I realize, also, it is to our best interest to work as a group for a common cause on common ground. It is only through cooperation and the welding of thought and opinion that ultimately we shall reach a common viewpoint which will be of great benefit to ourselves, and

which will, more or less, stabilize our manner of approach to our many problems. Significantly, the approach to any problem must be basically sound, and we shall gain most by the cooperation and study of the viewpoint of all. This, I hope, will lead us finally to a common goal.

The universal appliance, as you know, is constructed of chrome steel. The principles involved in the use of it are not new. Basically, it is a combination of Angle's pin and tube, ribbon arch, and edgewise bracket mechanism, all contained in one bracket, used in conjunction with the lingual arch, as advocated and developed by Dr. John V. Mershon. It is really ingenious in that many types of tooth movement may take place simultaneously, due principally to the fact that more than one arch wire may be employed at the same time. The lingual arch is employed chiefly for the stabilization and immobilization of the molar teeth during the active movement of the other teeth through the medium of the labial arches. Also, the lingual arch may carry finger springs which will aid in lateral development of the arches, should the treatment of the case indicate such procedure. With it teeth may be rotated, corrected axially, buccolingually, or mesiodistally, intruded or extruded, all under perfect force control at all times. With this appliance it is possible to establish anchorage regionally in any part of the denture. Since the technical phases of the appliance have been presented to you before, I would, at this time, rather than repeat them, refer you to the very painstaking article* written by Dr. Ralph Waldron, of Newark, N. J., and, also to an article† by Dr. Richard A. Lowy, of Chatham, N. J.

In the use of any method to treat malocclusion, we must recognize that to accomplish our objective it is necessary to hold to definite principles of approach if we expect relative permanency in our finished cases. In the past, many of you have seen some sad failures following the use of unorthodox methods of treatment. We cannot be sure today that there is any appliance, either simple or compound, which may be used successfully in the treatment of all malocclusions, because in the very nature of things everything has its limitations. In the final analysis, we must recognize that there is no substitute for good judgment, sound theory, and correct diagnosis. Likelihood of success must be based on these factors and should be determined in advance, if this be possible, for the selection of our cases. To do so would save us a great deal of grief. You will agree that many cases come to us for aid which are far beyond our resources.

To make a realistic search for the basic causes of malocclusion, we cannot avoid the fact that it is the result of no simple cause or factor. Intrinsically it is the interplay of long antecedent dynamic forces, varying pressures, and growth factors of undetermined origin inherent in the individual, which, more or less from inception throughout the growth period, make themselves manifest. The extrinsic factors may be included in the category of habits of all sorts which, through their influence, act as a stimulus to cause many types of malocclusion, more particularly Class II, Division 1. Chiefly would I mention tongue and lip habits, abnormal breathing, abnormal deglutition, posture habits, and many others.

*The Philosophy Behind the Universal Appliance as Advocated by Dr. Spencer R. Atkinson, AM. J. ORTHODONTICS AND ORAL SURG. 29: 435, 1943.

†The Atkinson Appliance, AM. J. ORTHODONTICS AND ORAL SURG. 28: 351, 1942.

Recently Atkinson has written an article* on the permanent maxillary incisor, its development and growth, which is a masterpiece. In it he has brought to light the beginning of the maldevelopment of this tooth, and in a large number of cases he shows the result of developmental factors, hitherto, as far as I know, unknown. Certainly some inherent growth factor of undetermined origin at an early age was in a state of imbalance. The foregoing study and the work he has done in the past leads me to the opinion that through his prodigious research he has contributed equally as much as any man to our scientific knowledge, and to the promotion and well-being of orthodontics as a whole. He has certainly demonstrated how to treat malocclusion without obscurity and confusion. The essential element in the success of his theory and method of treatment is the simplicity and orderly manner in which he presents his strategy. First things come first. In his determination to follow definite principles without exception, his strategy has proven successful and I know he has helped others with their daily problems. His contribution to orthodontics has earned him a high place in the esteem in which he is held by his co-workers. In addition, a great deal could be said about the manner and spirit of his unselfishness. Time alone will measure the importance of his work. Measured by results thus far, what would be the prospects of orthodontics today were it not for all of our research workers?

In his theory of Class II, Division 1 malocclusion, he makes the following deductions: "In normal occlusion, as the denture develops over the average growth period of the individual, say age 18, the first permanent maxillary molar takes a position with its mesio-buccal root immediately under the key ridge." The key ridge, named by Atkinson in 1923, is a strong ridge of bone which projects downward from the anterior surface of the zygomatic arch, and usually covers the mesiobuccal root of the first permanent molar. Over a long period of investigation he has found this to be true in all mammals and it remains permanent throughout life. "A Class II, Division 1 malocclusion, therefore, is characterized by the forward or mesial movement of the first permanent maxillary molar anterior to the key ridge, in which case the mesio-buccal root of this tooth would occupy a position in the canine fossae. Consequently it follows, all of the teeth anterior to the first permanent molar would be in a Class II, Division 1 malocclusion. It may be confined to the buccal segments only of the superior maxilla with the anterior teeth in good skull relationship, and with other variations." The treatment of such a case would involve the distal movement of the buccal segments of the maxillary teeth to correct skull relationship and the establishment of occlusion with the teeth of the mandibular arch. During the course of treatment other corrections may be indicated: for example, the development of the mandibular arch, probably some rotations in both dentures as well as the correction of the overbite, if necessary. The universal appliance offers excellent means to accomplish this purpose. By establishing stationary anchorage to the mandibular arch, the teeth of the maxilla may be moved distally very readily and easily by the use of the span glider, first used by Case, and the application of intermaxillary elastics, moving the molars first, followed by the premolars and canines, and finally the correction of the anteriors if necessary. On close case analysis, many times we find very

*The Permanent Maxillary Lateral Incisor, AM. J. ORTHODONTICS AND ORAL SURG. 29: 685, 1943.

little major tooth movement needed to correct malocclusion. This appliance is ideal because it offers so many opportunities to the operator to stabilize the molar teeth and others which need no movement creating regional anchorage for the correction of the ones in malposition. There are many combinations and methods of approach to tooth movement which the ingenious operator may undertake with great safety and force control. For example, in a condition of crossbite in the molar region, a difficult tooth movement, it may easily be accomplished by the use of the lingual arch, employing on the side of anchorage a rectangular tube with a finger spring extending to the mesial surface of the first premolar for additional anchorage. On the opposite side or zone of movement, a round tube is used on the lingual surface of the molar band and the arch adjusted with a set out bend, and with very little expansion this tooth will move into buccolingual relationship very quickly. It will be observed that stationary anchorage was established on the opposite side of movement through the means of the rectangular sheath and the finger spring resting against the lingual surface of the two premolars. I have found it to be very easy to open space for impacted premolars in the mandibular arch by the application of a coil spring on both the lingual and labial arch, which work in harmony with each other. The molars are kept in correct buccolingual relationship with no tendency to rotate, as would be the case where only one labial coil spring is used. When the lingual arch is used with a coil spring in this fashion, it is necessary to employ round lingual sheaths of 0.030 diameter with stops welded or soldered in the region of the cuspid, or a continuous coil spring may be used from attachment to attachment. After the space is gained, rectangular sheaths may be adapted to the bands, if necessary, for a better stabilization of anchorage. I have found that, to widen the denture in a condition where the lateral incisors have erupted lingually and, I might say, almost behind the central incisors, a good plan is to use a lingual arch with finger springs with a right angle hook formed on the end of the spring to engage the mesial surface of the lateral incisors. This will gain width very quickly and safely. When sufficient width is obtained, a readjustment of the finger spring will move these teeth forward to their correct position in the arch. These are just a few modifications which I know are helpful. There are many more. Time will not permit me to go further, so, in conclusion, permit me to recommend this appliance to you wholeheartedly and with the assurance that if you use it, you will gain much enthusiasm for your work; also, you will find with the passing of time that many cases which on first examination appear to be formidable and forbidding, will, on the application of correct principles of procedure, unfold themselves very readily and acceptably.

Our specialty, as you know, requires and demands special aptitude as well as special training, and one must not find himself in the constant danger of a too circumscribed outlook. We can obviate this by a common plan of coordination and cooperation and by maintaining the closest contact with the viewpoint of all of our co-workers in fundamental science. Our new knowledge must not continue to be scattered. It must be gathered together so that the total of the wisdom available can be marshaled for the use of everyone. In order to know the secrets of Science one must search widely and call upon all of man's skill, so that one may turn these efforts to his own purpose.

901 Wainwright Building

TIMELY REMOVAL OF OBSTACLES AGAINST THE ERUPTION OF PERMANENT TEETH

B. Gottlieb,* Dallas, Texas

THE biologic force of eruption is a small one. The slightest obstacle against it may become effective. In such a case the movement of the tooth occlusally may be stopped. The formation of the root does not develop any more in the place procured by the occlusal movement of the formed part. It will develop apically, causing resorption of the corresponding bone. It seems that ankylosis develops under such conditions, possibly by contact of the dentine with the bone before cementum develops. Some additional biologic particulars may be involved. Their understanding could be expected by histologic observation of such a case. No movement of an ankylosed tooth can be stimulated by removing the obstacle, and no orthodontic treatment can be successful. It is known that ankylosis can stop the continuous active eruption at any stage, resulting in a seemingly shortened tooth.

The obstacles encountered appear to be twofold. The first possibility is represented by an ankylosed deciduous tooth. A large number of deciduous teeth become ankylosed in the process of resorption and repair. If no resorption of the ankylosis is caused by the next movement of the germ, the connective tissue between germ and deciduous tooth is destroyed. Contact between these two teeth develops, and the growing germ is confronted with an unsurmountable obstacle.

Contact between permanent germ and deciduous tooth may also develop in the absence of ankylosis of the deciduous tooth. In such a case the force of eruption causes a dislocation of the deciduous tooth. If an impacted permanent cuspid comes, for instance, in contact with the root of the neighboring lateral incisor, this tooth is moved too. In the first case immediate removal of the deciduous tooth, in the second case the removal of the impacted cuspid is indicated.

If, however, the deciduous tooth is ankylosed, no movement can indicate the contact. In such cases delay of the removal of the deciduous tooth may create irreparable consequences. Accordingly, we have to watch the time of shedding. If a delay occurs, it should be ascertained by x-ray if a permanent germ is present. In such a case the deciduous tooth should be removed instantly.

Another obstacle may confront the erupting permanent tooth in the form of scar tissue developing after surgical interference. The early extraction of a deciduous tooth may also be the cause. It is obstacle enough for the small erupting power. In such a case the occlusal surface should be exposed in time and kept so until tooth movement takes care of keeping the outlet open.

Two instances are shown for illustration. Fig. 1 shows the central incisors of a boy 8½ years old. The corresponding deciduous incisors were

*Baylor University, College of Dentistry.

Fig. 1.

Fig. 2.

Fig. 1.—Central incisors of an 8½-year-old boy. Normal eruption was prevented by persistent deciduous and supernumerary teeth. (Courtesy of Dr. R. E. Gaylord, Dallas, Texas.)

Fig. 2.—Normal eruption in a child of the same age. (Courtesy of Dr. R. E. Gaylord.)

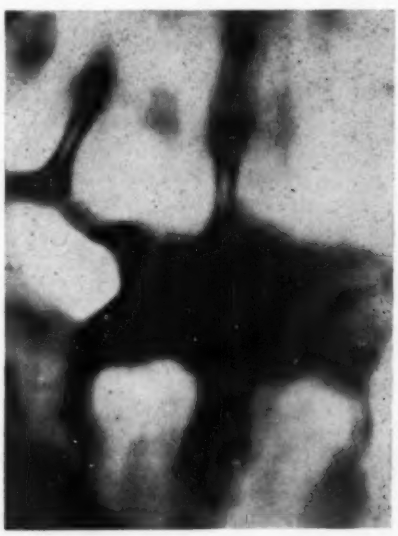

Fig. 3.—Deciduous molars were removed at the age of 13 years. The premolars did not move occlusally till 16 years of age. The removal revealed ankylosis. (Courtesy of Dr. A. L. Nygard, Dallas, Texas.)

extracted a year before, and two supernumerary incisors were removed three months before. The root formation is nearing completion, the lateral incisors are fully erupted. The cementoenamel junction of the central incisors is approximately in the level of the apex of the lateral incisors. The incisal edges are not erupted. It can hardly be expected that the central incisors will erupt if their crowns are exposed. If the suspicion that the teeth are ankylosed proves right, orthodontic help will not be effective.

For comparison, we see in Fig. 2 the central incisors of a child of approximately the same age. It is hard to decide if the roots in Fig. 1 are shorter or the space occupied by the pulp is larger than usual.

Fig. 3 shows another instance. A girl of 16 years with two submerged lower premolars presented herself. Only the occlusal surfaces were exposed; the other four surfaces of the crown were covered with soft tissue. The history revealed that the two deciduous molars remained in their place until the age of about 13 years. Then they were extracted and the occlusal surfaces of the premolars were exposed. In the following years they failed to come into occlusion. The surgical removal of these two premolars revealed that they were ankylosed. The deciduous molars were apparently ankylosed too. The premolars moved occlusally until they came into contact with the ankylosed deciduous molars and were stopped. The roots continued their development in the opposite direction, succeeding in causing resorption of the interfering bone. That led apparently to ankylosis.

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There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

In Memoriam

LANDIS HIXON WIRT

Dr. Landis H. Wirt of South Bend, Indiana, passed away on Friday, October 20, 1944, at the age of 64.

Early in his career Dr. Wirt practiced in Bombay, India, for seven and a half years; later, for a short time, he practiced in Muncie, Indiana.

In 1919, the year in which he and Miss Zolah Montgomery were married, Dr. Wirt turned to orthodontics and, for a quarter of a century, specialized in that field of dentistry.

Dr. Wirt served on the staff of the Children's Dispensary and Hospital Association and was active in the development of the dental program in the schools of South Bend.

He was a member of the South Bend Dental Society, the Northern Indiana Dental Society, the American Association of Orthodontists, the National Society of Orthodontists, and the Knife and Fork Club.

Dr. Wirt was born in Elkhart County, Indiana, June 7, 1880, the son of Cyrus and Susan Wirt. He received his early education in the Elkhart public schools. He traveled in many countries in Europe and Asia.

Surviving, besides his widow, are a daughter, Mrs. Hawley E. Van Swall, and a granddaughter, both of Syracuse, New York.

Dr. Wirt was a graduate of one of the early classes of the late Martin Dewey. His loss will be keenly felt among a host of friends in his specialty.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Congenital Macrogingivae (Fibromatosis Gingivae) and Hypertricosis. By Louis T. Byars, M.D., F.A.C.S., and Bernard G. Sarnat, M.D., St. Louis, Mo., *Surgery* **15**: 964-970, June, 1944.

Persistent marked congenital hypertrophy of the gingival tissues and hypertrichosis is reported in a 4-year-old girl. Because of the enlarged gingivae, few teeth are visible and a clinical diagnosis of anodontia or pseudoanodontia might be made. Because of the hypertrichosis, an endocrine dysfunction should be considered.

Case Report.—E. M., a white female aged 4 years, was originally seen March 6, 1940, because of profuse growth of body hair since birth and failure of the teeth to come through the gums.

The patient was the fifth of six children. No unusual history was obtained of the prenatal period. The delivery was normal and the only unusual thing noted was the presence of curly black hair down the back of the neck. This hair became more prominent, until, when the child was about 1 year of age, it was distributed over the entire back and extremities. The tips of the teeth did not appear in the oral cavity until the patient was 3 years old. There was no menstrual history. There was no family history of a similar disturbance. The siblings were light in complexion in contrast to the patient.

Radiographic studies of the skull, carpal bones, and jaws revealed a normal sella turcica and only two carpal ossification centers. Tooth development was normal. Deciduous teeth which had been exfoliated from the bone were trapped in the gum tissue. There was no evidence of missing teeth and the teeth were in normal relationship to the alveolar bone. (Fig. 1.)

Follow-up was continued for over three years and there was no unusual change in the patient. Several deciduous teeth which should have been exfoliated were still retained in the gingivae and the permanent teeth which should have been prominent in the oral cavity showed only the tips of the crowns. The patient was readmitted to Children's Hospital of St. Louis, June 6, 1943, and the various examinations were repeated with no significant findings. The ketosteroid level was within normal limits, indicating the absence

of a tumor or hyperplasia of the adrenals or a masculinizing tumor of the ovary. Feminizing tumors of the ovary were ruled out on physical examination.

July 6, 1943, under ether-nitrous oxide endotracheal anesthesia, all maxillary gingival tissue was resected down to the periosteum of the alveolar bone, exposing the crown of the teeth. (Figs. 2 and 3.)

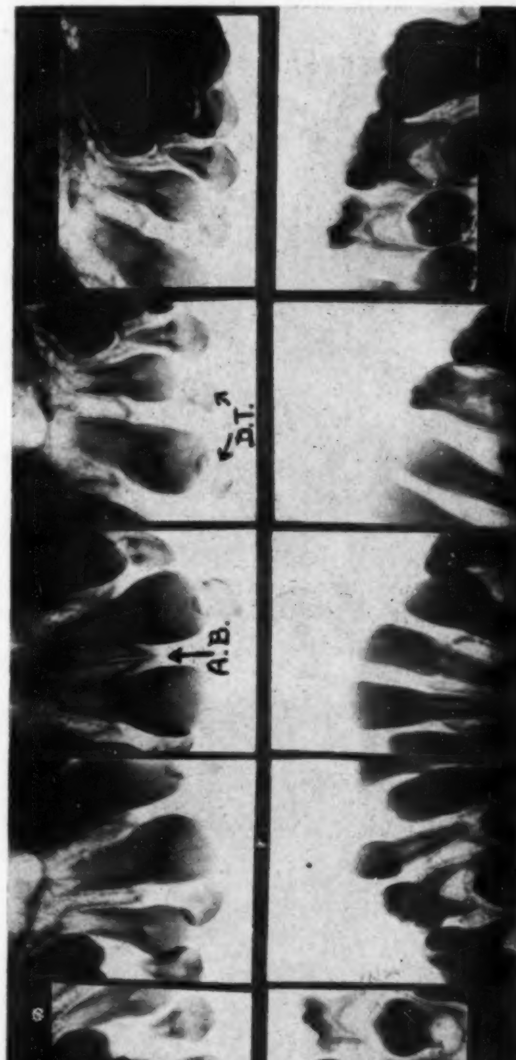
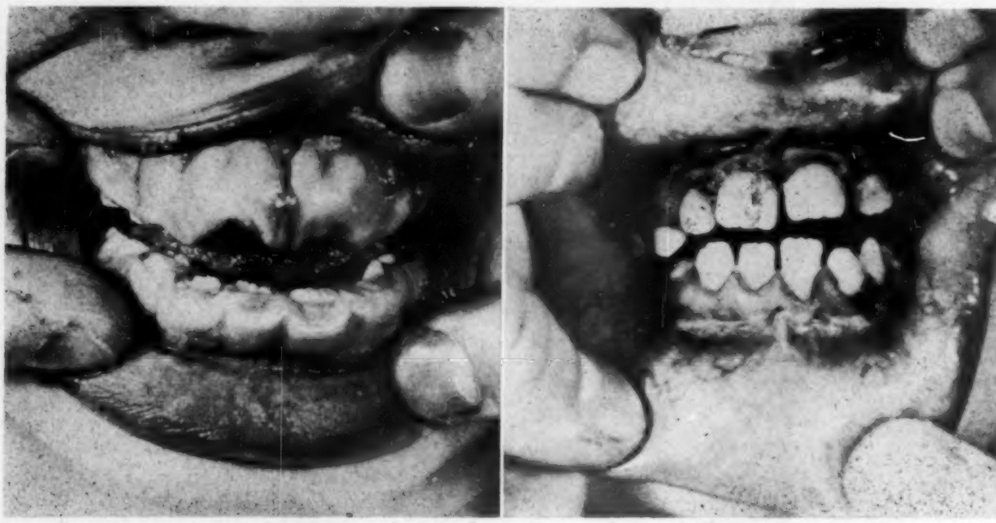


Fig. 1.—Alveolar bone (*A.B.*), showing normal relationship to teeth. Deciduous tooth crowns (*D.T.*) are shown trapped in the hypertrophied gingivae.

The histopathologic findings of the gingival tissue revealed that the epithelium was hyperplastic, and there was a relatively thick layer of keratin on the surface. There were numerous epithelial pegs extending deep into connective tissue. In the subepithelial layer there were many bundles of large

mature collagenous fibers. The lymphatics were dilated and there were a few isolated areas of round-cell infiltration. There was no other evidence of inflammation.

Histologic examination of skin obtained from the lateral thoracic wall revealed an increased pigmentation and hair follicles which were increased in size and number and extended through the dermis into the subcutaneous tissue.



A. *B.*

Fig. 2.—*A* shows hypertrophied gingivae covering the crowns of the teeth. *B*, Exposure of the tooth crowns after the operation.

A. *B.*

Fig. 3.—*A*, Profile before operation; *B*, after the operation.

The epidermis was normal in appearance except for a small amount of round-cell infiltration immediately underlying the epithelium and edema in the subepithelial tissue.

The postoperative course was normal. Removal of the abnormal gingival tissues accomplished several things. (1) An immediate cosmetic result was obtained with the normal exposure of the teeth. (2) The maxillary and mandibular teeth were now able to occlude and the normal process of mastication could be performed. (3) The lips dropped back into a more normal position. At the time of this communication the patient had been observed for more than five months postoperatively and there had been no return of the abnormal gingival tissue. (Fig. 4.)

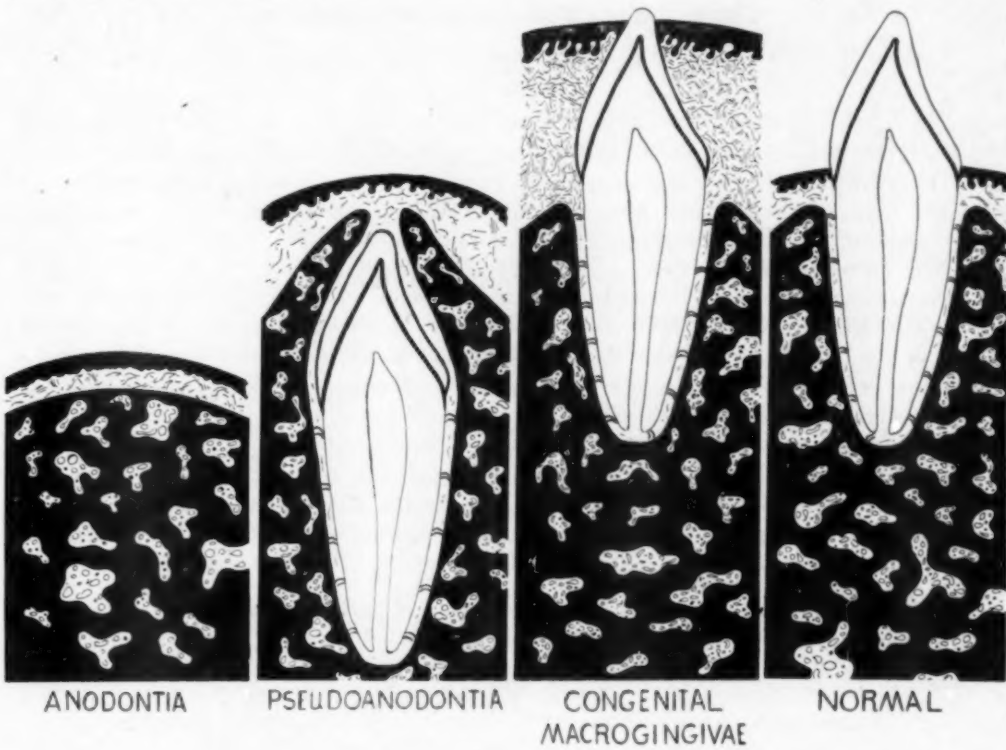


Fig. 4.

General enlargement of the gingivae is frequently seen in patients with blood dyscrasias, vitamin C deficiency, pyorrhea, hypertrophic gingivitis, those who are pregnant, or are taking dilantin sodium.

A case of congenital macrogingivae and hypertrichosis is reported in a patient, aged 4 years when originally seen. The gingivae were so large that the normally erupted teeth were completely covered. Treatment was by complete excision of the gingival tissue. The hypertrophy of the gingivae was due to extensive overgrowth of thick bundles of collagenous fibers in the subepithelial tissue. Thorough clinical and laboratory investigations of the endocrine glands revealed no correlation with either the macrogingivae or hypertrichosis.

News and Notes

The Southern Society of Orthodontists

The Southern Society of Orthodontists met in Atlanta, Georgia, on October 23 and 24, 1944.

The Atlanta Dental Society and the Fifth District Dental Society entertained the members of the Society and their guests at a cocktail party on Sunday afternoon, October 22.

The Scientific Program was one of the best the Society has ever had, as it brought out many fundamental problems faced by our profession. The outstanding contributions to this program were: "The Philosophy of the Labiolingual Technique," by Dr. Oren A. Oliver, Nashville, Tennessee; "The Philosophy of the Twin Arch Appliance," by Dr. Joseph E. Johnson, Louisville, Ky., the "Philosophy of the Edgewise Arch Mechanism," by Dr. Allan G. Brodie, Chicago, Illinois; "Possible Applications of Recent Findings in Heredity and Growth in the Practice of Orthodontics," by Dr. Byron O. Hughes, Ann Arbor, Michigan.

Every session of this scientific program was well attended and much was gained by those present from the above presentations.

On Monday night there was a banquet at the Atlanta Athletic Club honoring our distinguished member, Dr. Clinton C. Howard. At a ceremony fitting only to the recipient of such an honor, Dr. Howard was presented with a Gold Honorary Life Membership Card in the American Association of Orthodontists and Southern Society of Orthodontists, with the following inscription on the back of the card:

"Past-President of the American Association of Orthodontists.
First President of the Southern Society of Orthodontists.
Member of the American Board of Orthodontics.
Honorary member of the European Orthodontological Society.
Honorary life member of the Fifth District Dental Society of Georgia.
Member of the staff of the Good Samaritan Clinic for eighteen years.
Originator, through Endocrine Research, of The Howard Syndrome.
Scientific contributor and benefactor of mankind for thirty-one years."

Even though Dr. Howard has retired from active practice, his influence was felt throughout the meeting, and on many occasions his keen, alert mind came to the forefront in the discussions of many scientific questions arising during the meeting. No doubt it was one of the highlights in Dr. Howard's life, because he had his daughter, Mrs. Anthony Drexel, present with him at the banquet. During the social affair Dr. Howard's grandchildren, Anthony Drexel IV, Howard, and Diane Drexel, also made their appearance and were delightfully received.

The officers elected were:

President, Dr. Amos S. Bumgardner, Charlotte, N. C.
President-elect, Dr. J. E. Brown, Mobile, Ala.
Vice-President, Dr. E. W. Patton, Birmingham, Ala.
Secretary-Treasurer, Dr. Leland T. Daniel, Orlando, Fla.

Board of Directors:

Dr. E. C. Lunsford, Miami, Fla., three years junior member.
Dr. A. C. Broussard, New Orleans, La., director to American Association of Orthodontists.
Dr. G. Fred Hale, Raleigh, N. C., associate director.

Pacific Coast Society of Orthodontists

According to J. Camp Dean, President, the Pacific Coast Society of Orthodontists will hold its annual meeting Feb. 20, 21, and 22, 1945. It will be featured by discussion of the Johnson Twin Arch, the Edgewise, the Universal, and the Open Tube appliances.

Army General Hospital Named for Dental Corps Officer

Rodriguez General Hospital at San Juan, Puerto Rico, has been named in honor of Major Fernando E. Rodriguez, United States Army Dental Corps. Only one other Army General Hospital has been named for a Dental Corps officer. Major Rodriguez, who died in 1932, pioneered in the bacteriologic aspects of dental diseases. He received his D.D.S. from Georgetown University, Washington, D. C., in 1913, entered the Army as a First Lieutenant in 1917, and received his B.S. from Georgetown in 1924. He was a member of the District of Columbia Dental Society, a member of the International Association of Dental Research, and a Fellow of the American College of Dentists.

Photographs Aid Doctors

The sick and wounded may get well sooner because of photos taken by MAMAS. After the war, this organization will contribute to better understanding of disease.

Doctors behind all our far-flung battle lines have a new organization to help them treat the sick and wounded. When peace comes, this same organization, the MAMAS, will play an important part in making permanent the advancement in medical science which has been called "the only worthwhile result of any war."

MAMAS is not a maternal organization. The name is made from the initial letters of the Museum and Medical Arts Service. It was organized as part of the Army Medical Museum in 1942. Its purpose, as stated by Capt. Ralph P. Creer who heads it, is "to provide an adequate and efficient illustration service for the Medical Corps." Men of MAMAS are "shooting" for the records so that Army doctors and aid men will have vivid, accurate pictures to prepare them for the battle injuries they will handle.

Basic Courses Added to Reconditioning Program

Basic vocational courses are being added to the Army's reconditioning program. These courses will serve a twofold purpose by preparing the convalescent soldier for a more highly specialized position in the Army, if he returns to duty, or assisting him in securing a better position if he returns to civilian life. The plan is being initiated at four convalescent centers: Welch, Daytona Beach, Florida; Ft. Story, Virginia Beach, Virginia; Percy Jones General Hospital, Battle Creek, Michigan; and Wakeman General Hospital, Camp Atterbury, Indiana; and will be extended to other convalescent centers. Seven different "job families" will be represented by the courses which include basic training in Army and business administration, automotive mechanics, graphic arts, woodworking, agriculture, music and radio, and electricity.

Dental Corps to Maintain Strength at Peak Efficiency

In order to maintain its strength at peak efficiency, the Army Dental Corps plans to relieve from active duty a number of officers in certain categories and replace them as required with recent ASTP dental graduates. The War Department has made it clear that it does not desire dental officers to make application for separation under this policy. Selections will be made by the commanding generals from among those officers who are not physically capable of doing a full day's duty operating at a dental chair, those designated "limited service," and those for whom no suitable assignment exists.

Prize Essay Contest

The Research Committee of the American Association of Orthodontists is empowered by the Board of Directors to conduct a prize essay contest. The prize has been set at $200.00 and will be offered annually until further notice. The terms of the competition are as follows:

Eligibility.—Any student enrolled in a recognized university, or any person who has completed his or her formal education in orthodontics not more than two years prior to Jan. 1, 1945, is eligible to compete for the prize.

Essay.—The essay must represent a piece of original research having a direct bearing on the field of orthodontics. It may relate either to a biological or clinical problem and may represent material that has been offered in partial fulfillment of the requirements of a graduate or postgraduate degree, or any graduate, postgraduate or undergraduate contest. No papers previously submitted for publication or in press will be accepted. All essays must be in the hands of the committee not later than two months prior to the annual meeting of the Association. Consult periodic literature for this date. If no essay is deemed worthy by the committee, the prize will be withheld.

Award.—The prize-winning essay will be accorded a place on the scientific program of the annual meeting of the Association, at which time the prize will be awarded. The Association will retain publication rights of the first three choices.

For further information, address

ALLAN G. BRODIE, Chairman. Research Committee, A.A.O., 30 North Michigan Ave., Chicago 2, Ill.

New York Society of Orthodontists

The annual meeting of the New York Society of Orthodontists will be held at the Waldorf-Astoria Hotel, New York, New York, on Monday and Tuesday, March 5 and 6, 1945.

Thomas P. Hinman Mid-Winter Clinic

The Thomas P. Hinman Mid-Winter Clinic will be held at the Municipal Auditorium, Atlanta, Georgia, on March 25, 26, and 27, 1945.

Note of Interest

Dr. James J. Guerrero announces the removal of his office to 5522 West North Avenue, Chicago, Illinois. Telephone, Merrimac 4474. Practice limited to orthodontics.

Caution to Authors of Orthodontic Manuscripts

White plaster casts that are so profusely illustrated in orthodontic manuscript are difficult to photograph in a manner that will reproduce sharp detail in the resultant picture.

Photographs of casts accompanying orthodontic manuscript are often overexposed; therefore, it is practically impossible to reproduce them satisfactorily.

There are two ways that much of this difficulty may be avoided; one is to make the plaster casts with a slight shade of yellow in them, and another, suggested by Oppenheim, is to trace the sharp occlusal lines and gingival margins with a sharp lead pencil previous to the time the pictures are taken.

In the event that orthodontic authors will comply with the above suggestions, they will find illustrations reproduced in manuscript to be much sharper and far more satisfactory.

Editor.

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American Association of Orthodontists

President, Archie B. Brusse - - - - - - - - - - 1558 Humboldt St., Denver, Colo.
President-Elect, Earl G. Jones - - - - - - - - - - 185 East State St., Columbus, Ohio
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Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
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President, Frederic T. Murlless, Jr. - - - - - - - - 43 Farmington Ave., Hartford, Conn.
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President, Max Abrams - - - - - - - - - - - - - - 184 Shirley Ave., Revere, Mass.
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*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

Washington-Baltimore Society of Orthodontists

President, Meyer Eggnatz - - - - - - - - - - - Medical Arts Bldg., Baltimore, Md.
Secretary-Treasurer, William Kress - - - - - - - Medical Arts Bldg., Baltimore, Md.

Foreign Societies*

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President, S. A. Riddett - - - - - - - - - - - 42 Harley St., London, W. 1, England
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*The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis 5, Mo., U. S. A.